POPULAR SCIENCE

FOUNDED MONTHLY

OCTOBER

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A SHORT CUT TO FLYING

Page 47

NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS

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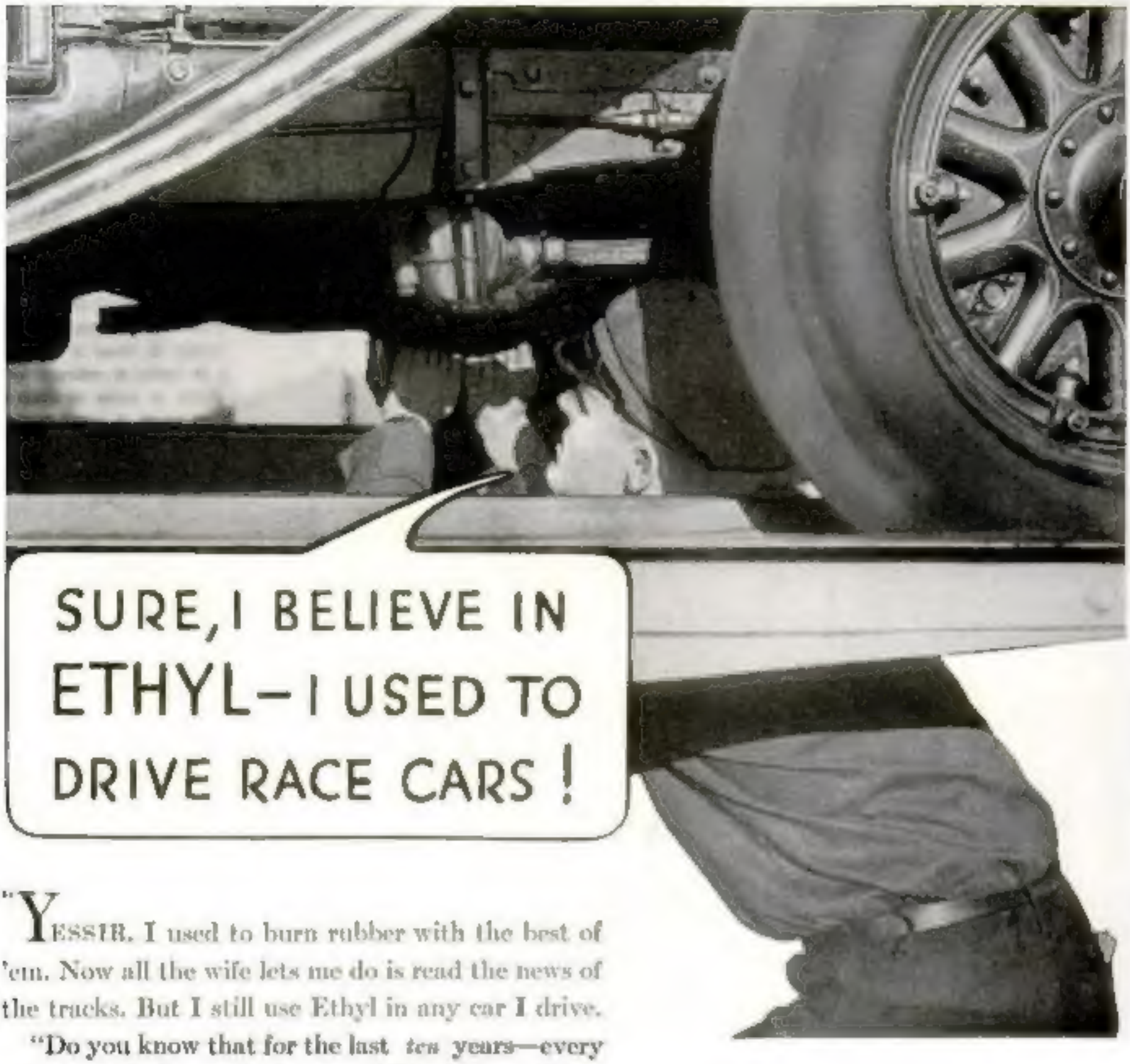

SURE, I BELIEVE IN ETHYL—I USED TO DRIVE RACE CARS!

"YESSIR. I used to burn rubber with the best of 'em. Now all the wife lets me do is read the news of the tracks. But I still use Ethyl in any car I drive.

"Do you know that for the last *ten* years—every winner at Indianapolis has used Ethyl? Any driver that went out on the track today without Ethyl in the tank—even with the best racing engine ever made—would be lapped something terrible.

"But don't get the idea that it's just a speed gas. You never see me making a racetrack out of the town streets—I use Ethyl to get more power out of my old corn popper. It prevents the pinging that kills all the life in a car. Treat your bus to Ethyl today and see if she doesn't buzz a lot better!" Ethyl Gasoline Corporation, New York City.

Ethyl contains lead. © E. G. C. 1955

NEXT TIME STOP AT THE ETHYL PUMP

"I'll say it's a Century of Progress

A CERTIFIED INTERVIEW WITH MR. STANLEY SOMERS OF WRIGHT FIELD, DAYTON, OHIO

HE didn't need a car, he didn't especially want a new car, he hadn't the slightest idea of buying a car. But one good look at the exhibits in the Chrysler Motors building at A Century of Progress—and Stanley Somers decided he was going to have a Plymouth.

He watched the tests of Floating Power engine mountings—the hydraulic brake display—the exacting material tests Plymouth always makes—the dramatic demonstration that shows how much *stronger* rigid-X double-drop frames are than conventional types.

Finally he rode with Barney Oldfield around the Chrysler Motors test track. And then, as he himself tells it, "To be fair, I looked at others . . . but it was Plymouth that got my order!"

The better you understand mechanics . . . the more you know of *good* engineering . . . the quicker you'll be to see the bigger value in Plymouth. Your dealer would like to have you compare Plymouth with others on twenty or more points.

Go "look at all three" . . . and see if you too don't agree Plymouth is a simply marvelous job at $445 and up F. O. B. factory.

• • •

Standard: 2-door sedan $465; 4-door sedan $510; rumble coupe $485; business coupe $445. De Luxe: 2-door sedan $525; 4-door sedan $575; conv. coupe $595; rumble coupe $545; business coupe $495. All prices F. O. B. factory, subject to change without notice.

See Plymouth at Chrysler Motors Building, Chicago Century of Progress.

$445
AND UP F.O.B. FACTORY, DETROIT

NEW PLYMOUTH SIX

WITH PATENTED FLOATING POWER

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ARTHUR WAKELING, *Home Workshop Editor*
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MONTHLY

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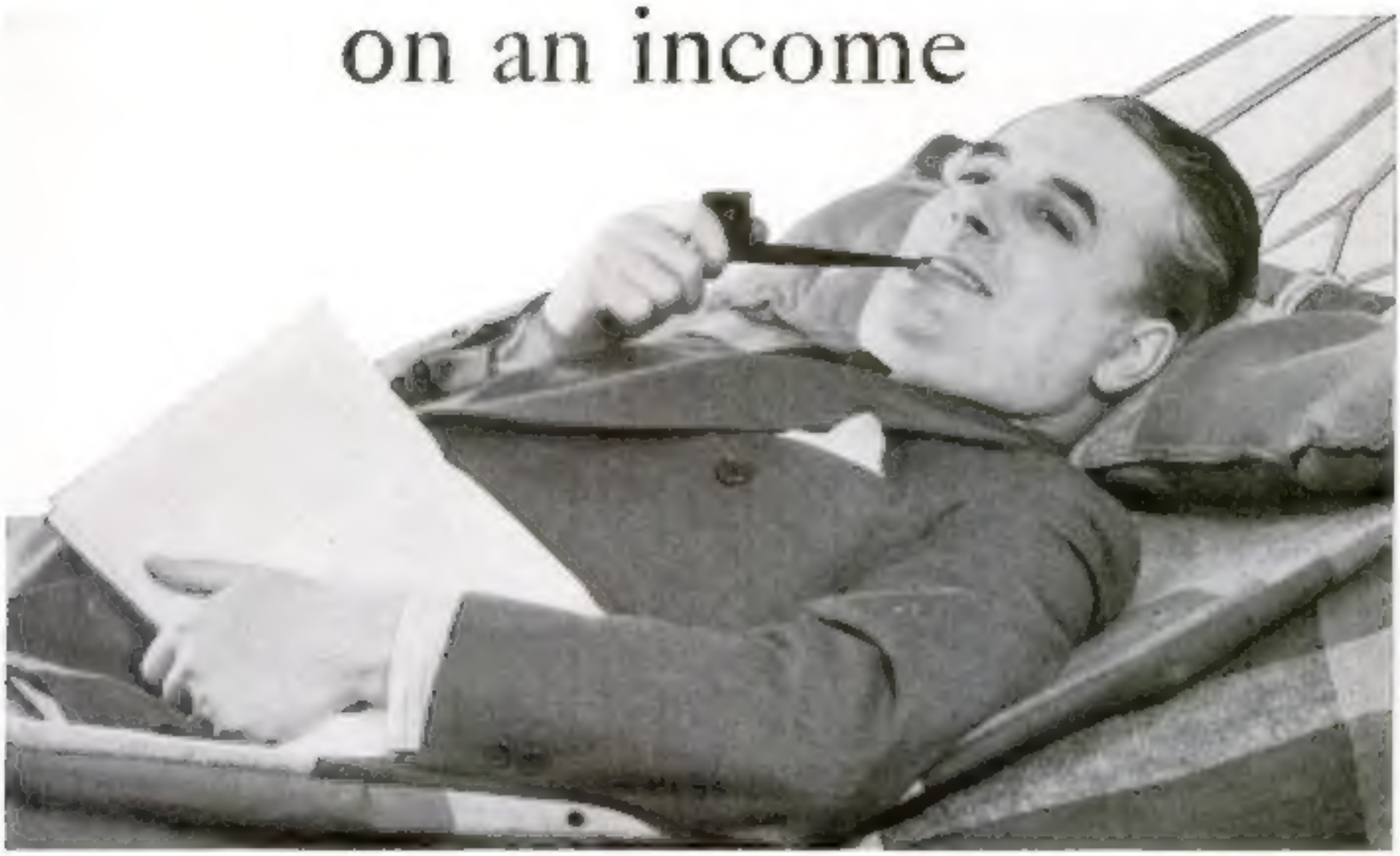
FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

How you can RETIRE on an income



$250 a Month for Life

DO YOU WANT to quit work some day? If you do, you should read this page carefully. You should then mail the coupon at the bottom of the page. You will receive by return mail, and without cost or obligation, an interesting free book which tells all about the Phoenix Mutual Retirement Income Plan.

How the Plan Works

This new Plan makes it possible for you to retire at 55, 60, or 65. You may provide for yourself a monthly income of $100, $200, $300, or more.

This life income is guaranteed to you by the Phoenix Mutual, an 80-year-old company with over six hundred million dollars of insurance in force.

Suppose you decide to retire on an income of $250 a month when you are 60. Here is what you get:

1. An income of $250 a month, beginning at age 60 and lasting the rest of your life. If you prefer, you may have a cash settlement of $33,750 at age 60 instead of the monthly income.

2. Upon your death from any natural cause before age 60, your wife (or other beneficiary) receives a cash payment of $25,000. Or, if preferred, your wife receives a monthly income for life.

3. Upon your death from accidental means before age 60, your wife receives a cash payment of $50,000. Or double the monthly income for life.

4. If, before age 55, serious illness or accident stops your earning power for a certain period, you will thereafter receive a monthly income to live on during such disability, even if it lasts the rest of your life.

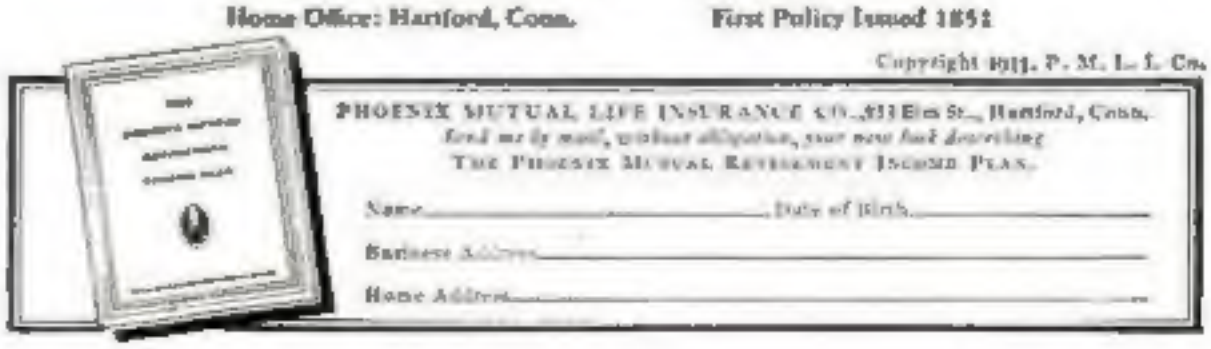
The cost of a Retirement Income depends upon your present age and upon the amount of income you wish to retire on. A Retirement Income does not have to be paid for all at once. It may be purchased on the installment plan. The payments are usually spread out over a period of 20 years or more. Naturally, this makes the payments comparatively small. One of the great advantages of this Plan is that it begins to operate the minute you pay your first installment. Even though you should become totally disabled, you would not need to worry, because your installments would be paid by us out of a special reserve fund.

Send for the Facts

A 24-page book tells how you can retire on an income—how you can provide money to send your son to college—money to leave your home free of debt—money for other needs. Send for your copy now. No cost. No obligation.

PHOENIX MUTUAL
LIFE INSURANCE COMPANY

Home Office: Hartford, Conn. First Policy Issued 1851



POPULAR SCIENCE MONTHLY for OCTOBER, 1933

MODELS

PHOTOGRAPHY

NEW DEVICES FOR THE HOME

NEW PROCESSES AND INVENTIONS

UNUSUAL FACTS AND IDEAS

CRAFTWORK

WOODWORKING

IDEAS FOR THE HANDY MAN

HINTS FOR THE MECHANIC

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Everything You Need to make this Cruiser

WITH a pocketknife, some single-edged razor blades, and a few simple tools that are to be found in every household, anyone can now build a beautiful 12 in. long model of the powerful new U. S. battle cruiser *Indianapolis*. Our complete kit of materials makes it easy—so easy, in fact, that the man or boy who has never before constructed a model is certain to be entirely successful.

The kit contains the hull block sawed to the correct outline and with the various deck "steps" cut out. With such a good start, you cannot fail to lay out the rest of the work accurately, especially as there is a blueprint and an illustrated instruction sheet to guide you.

In addition, there are seven pieces of white pine for making the various turrets, deck units, and lifeboats; round stock for the funnels and towers; sheet metal for rudder, propellers, shaft braces, and anchors; cardboard of the correct thickness for the funnel bases, turret mounts, and other parts; soft wire in two sizes for masts, derricks, guns, davits, cross arms, flagpoles, and the like; an envelope of casein glue, and three bottles of the highest grade enamel.

Postpaid Complete $1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit with enamel finishes and blueprint for building a 12-in. model of the U. S. cruiser *Indianapolis*. I inclose $1.50.

Name.....

Address.....

City..... State.....
(Print very clearly)

Posed by professional models

Skinny! New easy way adds pounds —*double quick!*

Astonishing gains with sensational new double tonic. Richest yeast known, imported beer yeast, now concentrated 7 times and combined with energizing iron. Gives 5 to 15 lbs. in a few weeks.

FOR years doctors have prescribed yeast for skinny, run-down men and women who want to put on flesh. But now, thanks to a remarkable new scientific discovery, you can get even better results—put on firmer, healthier flesh than with ordinary yeast—*and in a far shorter time.*

Not only are thousands quickly gaining pounds of solid, beauty-bringing flesh—but other benefits as well. Muddy, blemished skin changes to a fresh, glowing, radiantly clear complexion. Constipation, poor appetite, lack of pep and energy vanish. Life becomes a thrilling adventure.

Concentrated 7 times

This amazing new product, called Ironized Yeast, is in pleasant tablet form. It is made from specially cultured, imported *beer yeast*—the richest yeast ever known—which through a new process has been concentrated 7 times—*made 7 times more powerful.*

But that is not all! This marvelous, health-building yeast concentrate is then *ironized*—scientifically combined with three special kinds of iron which strengthen and enrich the blood—add abounding new energy and pep.

Watch the change

Day after day, as you take Ironized Yeast, you'll see ugly, gawky angles fill out. Hollow chests develop and pipe-stem arms and legs round out attractively. Complexion becomes radiantly clear—indigestion disappears—you'll have new, surging vitality, new self-confidence.

Skinniness dangerous

Authorities warn that skinny, anemic, nervous people are far more liable to serious infections and fatal wasting diseases than the strong, well-built person. So begin at once to get back the rich blood and healthy flesh you need. *Do it before it is too late.*

Results guaranteed

No matter how skinny and weak you may be, this marvelous new Ironized Yeast should build you up in a few short weeks as it has thousands of others. If not delighted with results of very first package, your money instantly refunded.

Only be sure you get genuine Ironized Yeast, and not some imitation that cannot give the same results. Insist on the genuine, with "IY" stamped on each tablet.

12 Lbs. in 3 Weeks
"After taking Ironized Yeast three weeks I gained 12 pounds." *Frank Pierance, 8515 S. Washtenaw Ave., Chicago, Ill.*

14 Lbs. in 21 Days
"Before 21 days were up I had gained 14 pounds. My complexion was muddy and is now perfect." *Yvonne Murray, 906 Dixie Overland Blvd., Shreveport, La.*

14 Lbs. in Month
"I have gained 14 pounds in a month." *Joseph H. Cieback, 3 Allen St., New York, N.Y.*

Special FREE offer!
To start you building up your health *right* away, we make this absolutely FREE offer. Purchase a package of Ironized Yeast at once, cut out the seal on the box and mail it to us with a clipping of this paragraph. We will send you a fascinating new book on health, "New Facts About Your Body", by a well-known authority. Remember, results are guaranteed with the very first package—*or money refunded.* At all druggists. Ironized Yeast Co., Dept. 4510, Atlanta, Ga.

INFLATION OR NO INFLATION...

These Prices Always Go Up!

By LEON MEADOW, *Financial Editor*

RECENTLY the writer saw a newspaper item about the purchase of life insurance by young men about to embark upon college careers. In thinking about it, the writer realized that while these columns had often been devoted to life insurance, its application to young men between the ages of eighteen and twenty-two or so, had never been outlined completely.

One of the reasons for this neglect can be laid to the fact that the public in general has been so thoroughly educated to the benefits of life insurance, and so entirely sold on its merits, that a discussion of life insurance for young men seemed rather unnecessary.

Perhaps it is, insofar as everyone will admit that life insurance at an early age is a great thing. There are many reasons to back up this assumption. And the major reason behind it all, we believe, is the peculiar set of conditions which surround the matter of life insurance. That is, the fact that age and health are in themselves two of the basic principles of this form of financial protection.

There can be no speculation about the price of life insurance. You can't buy it in the open market. You can't wait for a lower price. Automatically, as each year goes by, it becomes more expensive for all of us. Inflation or no inflation, sound or unsound currency, the price of life insurance always goes up. On the other hand, the sooner a young man starts, the less he pays for his protection, and the earlier he reaps his benefits in the form of life income.

HEALTH, too, is tremendously important. Without exaggeration, I know a dozen elderly men who have told me in the last three years that one of the greatest regrets of their lives was their failure to purchase life insurance at an earlier age. Not that the increased cost was the stumbling block. For, almost every one of those men was willing and able to pay double the premium cost—if they could have bought insurance. But they couldn't, under any circumstances. Their health was against them. They were no longer insurable, at any cost.

This is important. The young man of twenty who qualifies for life insurance by passing the medical examination required, may not be insurable at thirty, or forty. Since none of us knows what the future holds in store for us, the wisest thing we can do is take advantage of the present.

Assuming, then, that no one questions the need or advisability of buying insurance at an early age, the next and equally important question is "what kind of insurance to buy?" Here we enter into a discussion of values which, in the last analysis, must be applied to each man's particular circumstances. Yet, there are certain general factors which operate alike in almost all cases.

Take a young man of twenty, out of school, working at a moderate salary, looking toward the future with normal possibilities for a reasonably successful life. What kind of insurance should he buy?

The first answer is insurance that will bring him an income at a later age, when his earning power is definitely on the decline. Income insurance is the safest, cheapest path he can take to financial independence. Assuming that he has no dependents at the age of twenty, his first consideration is himself.

SOME people will argue that ordinary life insurance is cheaper than income insurance and that, at his age, relatively expensive policies are often too burdensome to carry. Let's dig in a little deeper. Ordinarily, straight life insurance, at twenty, costs $18.00 a thousand to buy. One thousand dollars worth of endowment insurance, maturing at sixty, costs $22.80. That sounds like a difference of $4.80 in favor of ordinary life. Actually it isn't. The average dividend on ordinary life over a period of forty years is about $6.75. If the dividends were taken each year, the net cost of ordinary life would be approximately $12.25. On the type of endowment insurance described the average dividend for the same period is around $9.80. This would make the net premium $13.00.

On a cost basis, then, ordinary life is seventy-five cents a thousand cheaper. BUT—to balance that—or, I should say, to over-balance that, is the fact that in the thirty-fifth year after a man of twenty —has bought a one thousand dollar endowment policy, the cash value of his policy is almost $800, whereas ordinary life insurance (Continued on page 7)

THESE PRICES ALWAYS GO UP!

(Continued from page 6)

in the same year is worth a bit over $400. In other words, endowment is almost double in actual cash or loan value.

Of course, all this is apart from the comparative merits of both policies for a man of twenty. Here there can be no doubt. For $13 invested each year on endowment insurance he receives $1,000 when he reaches the age of sixty. Or, if he leaves the dividends with the company, for a $22.80 annual gross premium invested, he receives in the neighborhood of $1,750 at sixty. Surely, that is better than *continuing to pay premiums* on ordinary life insurance when he reaches that age. All the more so, since both types of policies are equal in respect to death benefit values—each calling for the return of the face value of the policy, plus whatever accumulated dividends there are.

RETIREMENT Income Insurance is another form of life insurance which sounds more expensive to buy, but which is actually cheaper, and far more advantageous, for a man of twenty to buy. Retirement Income is not written in units of thousand dollars. It is written to bring in a definite monthly for life, starting in units of $10 a month. To secure that income for life, beginning at the age of sixty, you invest in $1,040 worth of Retirement Income Insurance. This costs the man of twenty about $30 a year. But the average dividends run to about eleven dollars, so if they are deducted, the annual cost is actually only nineteen dollars. In return for this amount is a monthly income of ten dollars *for life*, starting at sixty. Another point of importance on policies of this type is the fact that after their thirty-second year if they are in force, their cash value *exceeds* their face value. Upon event of death any year after that, up to maturity, the company pays out the *cash* value. For example, in the thirty-fifth year a Retirement Income Policy, guaranteeing a monthly income of ten dollars for life, has a cash value of about $1,250, and the same death benefit, although it was originally written for only $1,040 of face value.

Some time ago, the slogan "Buy It Now" was very popular. The appeal, of course, was a patriotic one, intended to stimulate national recovery. Where insurance is concerned "Buy It Now" is *selfish* advice. It means protect yourself while you can—and when it's cheapest.

INSURANCE BOOKLETS

Several reliable insurance companies have available free booklets on all types of insurance. We shall be glad to forward your requests for these booklets. When writing, please give type of policy you are inquiring about—if possible—and such details as age, financial situation, etc. Address Financial Editor, Popular Science Monthly, 381 Fourth Ave., New York, N. Y.

Our Readers Say

Would You Kill the Cars Or Start With the Drivers?

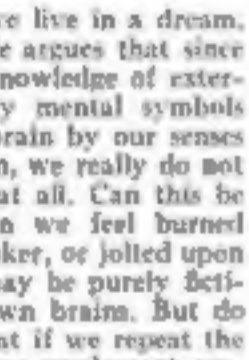
Two weeks ago, a dilapidated auto, going forty miles an hour, veered across the road and piled my new sedan on the curb a total washout. According to the financially irresponsible driver, "something broke" on the junk machine. It seems to me that what this country needs is a killer for old cars. There are too many out-of-condition machines, ripe for trouble, speeding down highways. Someone once made the wisecrack that if you put all the autos in America end to end you would have Sunday afternoon. The traffic is bad enough. But the junk cars are worse. Some states are beginning to require a mechanical inspection when the license is applied for. If all states will fall in line, unfit autos will be weeded out.—R.A., Chicago, Ill.

Life May Be a Dream But It's Just as Well to Duck

A SCIENTIST says that we live in a dream, walled off from reality. He argues that since we must depend for our knowledge of external objects upon arbitrary mental symbols of them, brought to our brain by our senses of sight, hearing, and so on, we really do not know what they are like at all. Can this be true? Granted, that when we feel burned after touching a red-hot poker, or jolted upon falling downstairs, these may be purely fictitious imaginings of our own brains. But do we not know definitely that if we repeat the unwise maneuvers, the same unpleasant sensations will surely follow? It seems to me that it is this definite predictability of events that distinguishes our waking life from the disordered imaginings of our dreams during sleep. It occurs to me that our more orderly waking sensations serve a practical purpose in preventing our "dream" life from coming to an end, whenever we see a taxi headed at us.—A.H., New Haven, Conn.

Does This One-Tree Orchard Hold the World's Record?

I WAS particularly interested in the article on "Midget Gardens" in a recent issue of your magazine. Near here, we have something equally remarkable—a whole orchard on one tree. One hundred and sixteen kinds of apples and one kind of pear all are fed from the same roots. The original tree was a twenty-year-old wild apple tree. F. A. Good, an amateur horticulturist, began grafting scions of different kinds of apples on this tree, eight years ago, as a hobby. This summer, the total number of his grafts has reached 117. I believe this is a world's record. If any other readers know of bigger "one-tree orchards," let them write in!—Mrs. F. C., Fredericton, N. B.



Try It on Your Own Bones, H.H.S., and Then You'll Know

DR. BARRAT did not make a serious error in stating that the bones in older people are more easily broken than those in younger persons. H. H. S., of New York, should get any book on physiology and anatomy and study the physiology of the bone. He will find that as the bone grows older, it becomes harder and *more brittle*, due to inorganic accumulations. If this explanation does not make clear the reason as to why the bones in aged people are more easily broken, although they are harder, he may experiment with a glass stirring rod and a steel rod of the same diameter and length by dropping the same upon the floor. The glass is harder than the steel, but it will be shattered. Which, I think, proves something regarding our ancient bones. —J.C.R., Youngstown, Ohio.

Suffering Golf Widow Demands an Invention!

I SEE by the papers we've got television—again. Oh, yeah? That, to some people, may be interesting if true. Me it leaves chilly, if not downright cold. What I want is a picture dodad on the telephone and thousands and thousands of long-suffering wives will join me in this demand. When the little woman (that's what you call a "wife", isn't it?) calls her Joe who is in the locker room, she should be able to see exactly what his condition is. If a picture of him appeared on the screen, he wouldn't be able to say in muffled, wet tones, "Just got in, darlin', and am all ready for a shower. Will be up in twenty minutes." In reality he is fully dressed and is standing at the phone with a glass of something cold in his hand and hasn't the slightest intention of leaving the locker room until the last notes of "Sweet Adeline" have been washed ashore. If this new television scheme will fit a phone, then I'm all for it. And please hurry or divorces will increase.—Mrs. N.G.P., Bronxville, N. Y.

Here's a Way to Solve The Spring-Acid Problem

IT IS C. S. Y. rather than H. J. P. who is confused in his terms in his answer to the thought-provoking query: What becomes of the energy stored in a spring under tension when it is dissolved in acid? Physicists say that energy is the capacity for doing work and is of two kinds, kinetic (energy of motion) and potential (stored energy). A tensed spring does contain energy because, under proper conditions, it is capable of doing work. In view of the law of conservation of energy, then, H. J. P.'s question was perfectly legitimate. What does become of the potential energy of the spring? My guess is that it is converted into heat. It should be demonstrable by a simple experiment to show that if two like springs, one of which is under tension and the other not, are dissolved in two like acid solutions, that the temperature of the former would be appreciably higher than that of the other.—C. A. H., Watertown, S. D.

London Launches Spirited Defense of Evolution

I WAS amazed recently at the smug dogma of C. C. J., Nanticoke, Pa., in regard to evolution. On what does he base the statement that there is no living proof of man's descent from mammals? There is, in any modern book on biology, proof of even more ancient ancestry, namely, evidence in the human embryo of fish descent. I state this hoping that it does not hurt the vanity of C. C. J. But I suppose he will tell us that God arranged these non-human features in the embryo in order to fool the biologists. Also, C. C. J., there is no doubt that parts of the Bible are historically correct, but there are also parts that are not so admirable. Its fairy stories were sufficient explanation for the simple folk they were meant to satisfy, but they do not bear modern scrutiny. I suggest to C. C. J. that he read "The Science of Life," by Wells and Huxley.—J. H. P., London, England.

Setting Everyone Right on The Iron Rust Problem

IN A recent issue of your magazine, N. C. T. tried to explain S. B. M.'s question about the rusting of iron by saying that water acted only as a catalyst. However, water enters into the reaction to produce rust. He has the mistaken idea that rust is an oxide of iron. Instead, rust is either a ferrous or ferric hydrate. The latter is formed when the ferrous type is exposed to the oxygen in the air. The first type can form only in the presence of carbon dioxide which acts as the catalyst.—R. A. C., Newell, Ia.

Radio Advertisers Want Their Money's Worth

OUR northern neighbors seem to have the right idea when it comes to throttling radio advertising. A recent Canadian radio law limits the period allowed for advertising announcements to a scant five per cent of the full program time. That leaves the soft-voiced announcers of a half-hour program just about ninety seconds to do their stuff. Seems like ample time to me. Why can't the powers that be pattern radio programs after the arrangement in a magazine? No adver-

tiser would think of asking a publisher to run his ad in large red letters across the pages of a story, or article. Why not separate radio advertising from the meat of the program in the same way?—L. K. D., Rich-

He Went Everywhere, Saw It All, and Came Back to Us

HAVE just finished walking my legs off and wearing out the seat of my trousers in wheel chairs in an effort to see the Century of Progress Exposition. In the course of my wanderings I reached your exhibit. When I got through the crowd and saw your splendid Mechanical Wonderland, I was certain that the World's Fair was worth while. Also it made me think better of my fellow men because there were so many of them deeply and intelligently interested in your exhibit. It convinces me there is some hope for the fool race after all. I want to thank you for what your exhibit taught me.—J. B. W., Madison, Wisc.

That "N" Problem Is Back For Further Discussion

CONCERNING the solution of the "N" problem in a recent issue of POPULAR SCIENCE MONTHLY, B. R. F. of Exeter, N. H., evidently made the mistake of assuming the prolonged sides of the diagonal of the N to intersect the corners of the "uprights." This would be giving the width of the diagonal a smaller value than that specified in the problem as given by G.H. of Lohrville, Ia. I found that the quickest way to find the area of the N was to calculate the area of the "open spaces" and subtract this from the twenty-four square inches given by the outer dimensions of the figure. In order to do this, I found it necessary to use trigonometry. With a slide-rule, the closest I could get to the correct answer was [illegible] square inches. Here is a problem which should prove interesting, at least, if not difficult. Find two numbers, excepting zeros, such that their sum, product, and the difference of their squares will all be equal. This problem should have two sets of answers.—N. D. W., San Bernardino, Calif.

This Astronomical Society Builds Its Telescopes

DUE to a lack of interest in astronomy in the Bronx, we have formed an astronomical society to encourage the building of telescopes and the study of other sciences allied to the study of the stars. We have one completed homemade reflecting telescope and in the near future expect to have as many of them as we have members.—BRONX ASTRONOMICAL SOCIETY, New York, N. Y.

Harassed Auto Owner Calls For Three Needed Inventions

AFTER spending half a day working on the old bus and taking down the screens, I want to nominate for the Hall of Needed Inventions three things: 1. A car polish that will not lose its luster. 2. An automobile battery that requires no water or attention. 3. Windows and screens combined. (Maybe this will be glass that can be made porous!) If anyone can invent any of these things, I'll be ready to vote for him for President!—A. F., Baltimore, Md.

Radio Ham Puts in Bid For Short-Wave Receivers

KEEP up the good work on radio. I am a radio fan and experimenter badly bitten by the radio bug. Your chemistry is coming along fine. Some of these knockers who think they are smart ought to get a dose of their own medicine. I like your dope on transmitters, but I think there might be plenty of BCL QRM where you use modulated c.c. But, however, it is a mighty fine outfit for a beginner like me. I am new in the ham business. Maybe some of us guys who have built your radio equipment would like to have some better short-wave receivers to pull in the hams. You might give us some new sets upon which we can try our hands.—A. VAN A., Bayside, N. Y.

Ice and Water Problem Is Now Definitely Settled

IN answer to L. W. B. Kingston, Wis., who wants to know why ice floats, I should like to say: In studying water and ice, we find that water, when cooled to a temperature below 39.2 degrees Fahrenheit, expands and this expansion continues until ice is formed. The result is that one cubic foot of ice weighs 57.5 pounds while one cubic foot of water at 60 degrees Fahrenheit weighs 62.3 pounds. The specific gravity of ice is .92. This is the reason ice floats in water.—H. W. H., Rockport, Texas.

How to Find Miles Per Hour In All Racing Events

AS AN official timer for races, I have had many persons ask me how we figure the miles per hour of a race or lap. Of course, this is simple arithmetic, but it is surprising how few really know how to figure it. Here is how it is done: To get miles per hour multiply the miles run by 3,600 and divide the product by the time in seconds. Example 1: An airplane goes 30 miles in 9 minutes and 36 seconds. Get miles per hour. Nine minutes and 36 seconds are 576 seconds. Now 30, the number of miles, is multiplied by 3,600 and the product divided by 576. The quotient, then, is the miles per hour, or 187.5. Example 2: A sprinter runs 100 yards in 10 seconds. How many miles per hour is that? Since there are 1,760 yards in a mile, the miles run are 100 divided by 1,760. This quotient is then multiplied by 3,600 and the product divided by 10, exactly as in the first example. The time, we find, is 20.45 miles per hour. Announcers at racing meets usually give the time for each lap and if you know the length of the course, you can figure the speed per hour by this formula which you can easily remember and use with no trouble at all the instant the lap time has been announced.—F. P. V., Bakersfield, Calif.

Here's a Simple Way to Solve The Puzzle About Ether

HERE is an idea for a solution of the scientific problem, "What does the ether consist of?" As far as I know, no way has been found to secure a sample of the ether, but it can be done in this way: Send a radio-controlled rocket into the ether with a valve controlling the inflow of matter or ether into a vacuum tank. The valve would be timed to open when the rocket got above our atmosphere. When the rocket had reached a point about eight miles above our atmosphere, the vacuum tank would be released and lowered safely to earth by parachute. All of this could be controlled from a balloon similar to Professor Piccard's. This balloon would be ten miles above the earth, presumably above the Heaviside layer. Observations made by the scientists in this balloon and later analysis of the contents of the vacuum tank would disclose the make-up of the ether and also give the true answer to the speed at which light passes through it.—E. C. J., Westport, Conn.

Solving This One, Merely A Matter of Common Sense

ONE of your correspondents about six months ago asked for a right angled triangle whose long side was [illegible] to its short side as its hypotenuse was to its long side, he said it was not so difficult. But I have given it a lot of thought and can only make the grade by method of trial and error. Won't he come to the aid of a distracted party?—Here's a fifth-grade one (a truck one perhaps) that came to me recently. With the given dimensions it is required to find the radius of the circle. The inscribed figure is a rectangle. To solve it requires only elementary knowledge of geometry, in fact one might say only a modicum of common sense, or something.—P. C., Troy, N. Y.

Which Pulls Harder—the Fore or Aft Horse?

HERE is one that I would like to have some one answer or the [illegible] such as those held by the popular illustration of Justice, will, if more weight be placed in one pan than in the other, indicate which side is the heavier by that side dropping to a lower level and staying below the balancing line. Now take a team of horses pulling a load, one horse drop farther back. Which of the two horses is pulling the greater part of the load? Ask almost any farmer and he will tell you that the hind horse pulls more. I [illegible] why? The heavier of the pans of the scale is down, but in the case of the horses pulling a load, the horse pulling the harder is back. Does the fact that the scale hangs vertically and the horses pull horizontally have anything to do with it? Does it make a difference if the load is moving? Does the whole thing revolve around a question of anchorage and leverage, both of which may shift, depending upon whether the load is in motion or not? I shall be delighted to receive, from some reader, clear answers to these questions, which have been worrying me.—O. I. G., Rockton, Ill.

How Would Portable Lightning Rods Do for the Bathers?

LAST summer, half a dozen people were killed by lightning on bathing beaches near here. Every year the same thing happens. Why wouldn't it be a good idea to equip all public beaches with flagpoles with lightning rods at their tops? Then, if the lightning struck, it wouldn't hit the bathers. I have no idea what could be done to save those who insist on staying in the water during a thunder storm, but maybe the sharks and swordfish could be equipped with lightning rods to protect such suicidal bathers. Or maybe the fate of such persons is of no importance.—Mrs. E. R., New York, N. Y.

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POPULAR SCIENCE
MONTHLY
October 1933 Vol. 123, No. 4
RAYMOND J. BROWN, Editor
FOUNDED 1872
SIXTY-SECOND YEAR

Air Leaks *in* Polar Waste

HOLD SECRETS OF COMING Weather

By ANDREW R. BOONE

RIVERS that run in the sky. Gulf streams that flow through the upper blue. Tides that ebb and flood in the atmosphere. In these phenomena of nature, scientists are seeking a key to the mystery of weather

Far to the north, at this writing, "Polar Year" expeditions are packing up their instruments after studying the strange air leaks of the Arctic ice-cap. In California, transport pilots are plotting a daily vertical cross section of the air along their routes. At half a dozen American airports, Weather Bureau planes climb into thin air once every twenty-four hours to record the humidity, velocity and temperature of the various strata of the atmosphere

Disturbed currents of the upper air have just been linked by government experts in the Middle West with the drought which has done the most damage of a generation to wheat and oats. The great drought of 1930, which came later in the summer and was the most severe of Weather Bureau history, was attributed by Dr C F. Marvin, chief of the bureau, to a general stagnation of the air over the North American continent

Consequently, it is believed that greater knowledge of air currents will lead to a better understanding of how droughts and floods are born and will enable meteorologists to make long-range forecasts of the coming of abnormal weather

The scientists who are carrying on these researches work in the largest laboratory in the world—the whole atmosphere that surrounds the earth and extends for more than fifty miles above it. Sixty million billions of tons is the weight of this gaseous envelope, a total that would equal the weight of a layer of rock 800 feet thick covering the entire land area of the United States!

This envelope is in a constant state of change. Heated air rises; cooled air descends. Rising air leaves a partial vacuum

WEATHER RECORDS MADE BY PLANES

Humidity, air pressure and temperature are automatically recorded by an aerometeorograph when it is carried aloft by a plane. The instrument, one of which is shown at upper left while another can be seen on the wing of the plane, above, was recently invented in Germany. Its records are made on lampblack paper as shown at right

This ground operator is receiving radio weather reports from flyers who record the air pressure and wind velocity at each 1,000 feet of altitude. These data give a real cross section of the atmosphere

With the psychrometer which is shown here being prepared for use the humidity of air is found

and other air rushes in. In this way winds are formed. Some winds blow by fits and starts, others form steady currents that sweep forever in the same direction; and some continue on their curving courses half around the world.

Queer bits of news crop up occasionally to give evidence of the long-distance flow of these aerial rivers.

Last year, for instance, a toy balloon was released at Watervliet, N. Y., and picked up in Derbyshire, England. Carried by the wind, it had crossed the Atlantic. A few months ago, bright yellow rain fell in Belgrade, Jugoslavia. It was tinted by dust from the scene of a distant earthquake. Similarly, red snow, which covered the fields of Japan last winter, was produced by dust particles blown from the Mongolian desert far to the westward in China. When Krakatoa, a volcano near Java erupted with a terrific explosion in 1883, the dust it hurled into the upper atmosphere was borne by the winds completely around the globe, causing lurid sunsets and unusual cold.

Such sky currents carry weather in the making as well as dust and toy balloons. The vast, and as yet little-understood circulation system of the upper atmosphere is constantly brewing wind and rain and an infinite variety of weather. More than twenty centuries ago, the writer of Ecclesiastes observed: "The wind goeth toward the south, and turneth about unto the north, . . . and returneth again according to his circuits." Just what these circuits are is the problem now occupying science.

One ingenious theory of how the circulation system of the world's atmosphere functions has been advanced by the noted Norwegian meteorologist, Dr. J. Bjerknes, who recently visited A Century of Progress Exposition, at Chicago.

According to his hypothesis, the gaseous envelope above the earth is divided into compartments, in which there is a regular interchange of warm and cold air masses. For example, in the North American compartment the heated air from the tropics rises and flows northward while the cold air from the Arctic descends and moves south. More than 300,000,000 tons of air, he calculates, move in this way over North America. At about the latitude of Alaska, the two walls of air meet. But they do not mix.

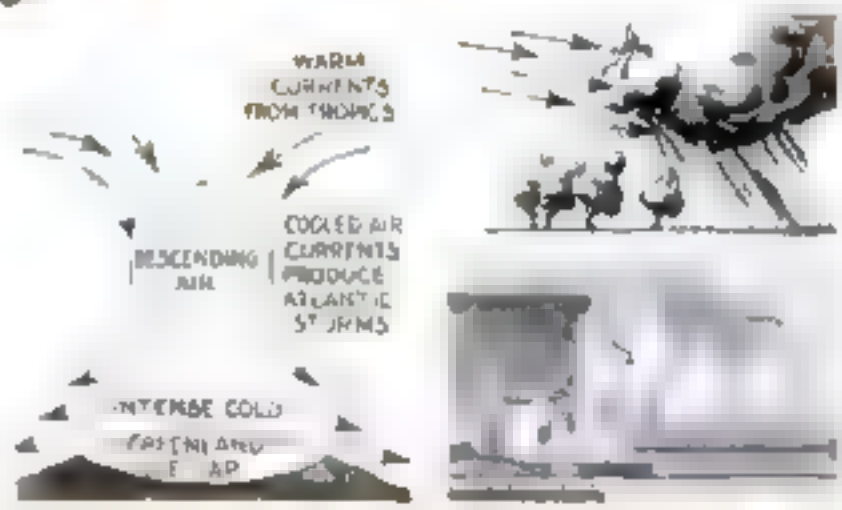
The cold air sweeps to the west and the warm air is deflected to the east. Sometimes, the moving masses of warm air climb over the polar currents. Again, the cold air breaks through and surges south. What happens along this Polar Front, Dr. Bjerknes maintains, produces the high- and low-pressure areas of the middle latitudes and determines the sort of summers and winters we have.

Two years ago, the "radio probe," invented by the Russian meteorologist, Dr. P. Molchanov, proved that one phase of the Norwegian's hypothesis is entirely correct. When the Graf Zeppelin made its Polar flight, Molchanov released several of his special sounding balloons, with their tiny radio sets automatically reporting changes in temperature, and discovered that at an altitude of ten miles above the Arctic ice the air began to get warmer. This proved that currents from the tropics do overlie the cold air of the northern ice-cap in accordance with Bjerknes.

An important feature of the labors of the "Polar Year" expeditions, which have been working in the Arctic since the summer of 1932, has been a search for air leaks in this giant reservoir of cold air hanging over the Arctic regions. These leaks, or places where the cold air most frequently surges south, have much to do with bringing cold waves to the United States in winter and cool, wet spells in summer. The blocking of these channels by the walls of warm air produce mild winters.

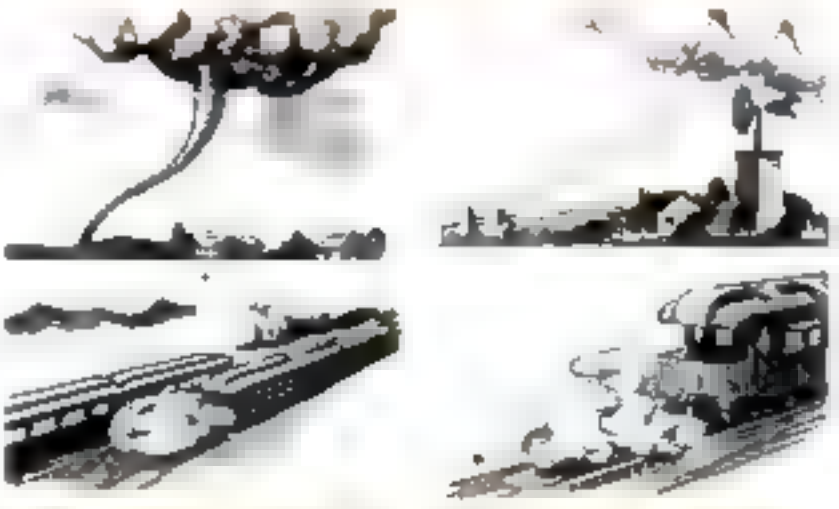
There are two main paths down which these tongues of cold air appear to travel. One is down the Mackenzie River valley in Canada, and thence to the Mississippi basin of the United States. The other is down Hudson Bay and across the Great Lakes. Air leaks that effect the weather in Europe and Asia are visualized as coming down over the North Atlantic and Pacific oceans and over Finland and northern Russia.

When the "Polar Year" records are checked and correlated, it is expected they will give us more definite information concerning these rigid masses of air that flood down from the north. A key to our



Warm air from the tropics, rapidly cooled and then, rushing southward, is the cause of North Atlantic storms, scientists say

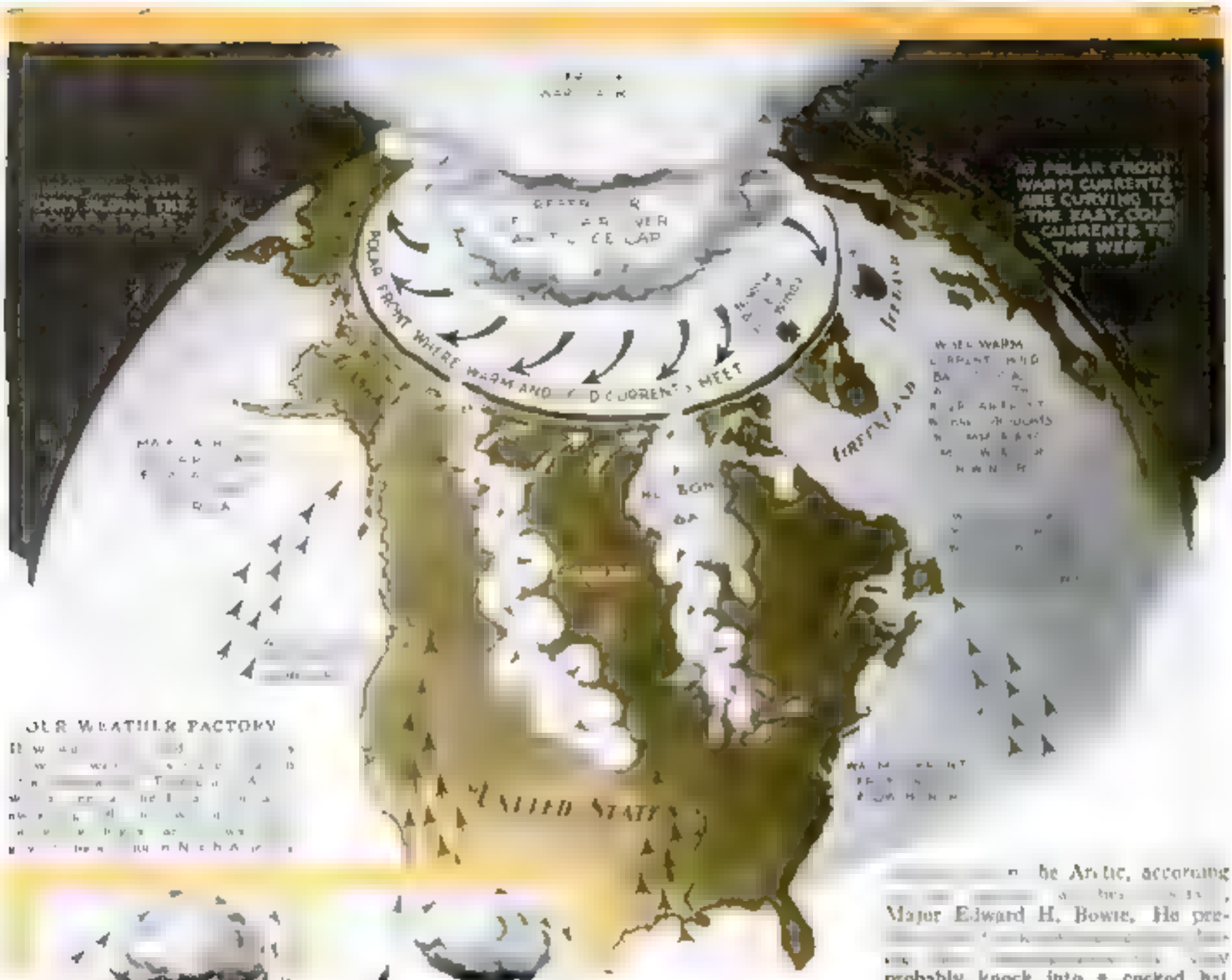
Steam condensed against a cold window pane shows how rain is the result of warm, moist air carried aloft and so condensed



Trains passing at high speed form a whirling air pocket. In the same way, passing air currents may form our tornadoes

Air sweeps into the partial vacuum at rear of a moving train. This illustrates why winds blow from high- to low-pressure area

Illustrations Show the Development and



he Arctic, according Major Edward H. Bowie. He pre- probably knock into a cocked hat much of what the text-books on weather have been teaching."

Another scene of recent air-current research is Greenland. At the "North Pole of the Winds," a few years ago, Prof. William H. Hobbs, University of Michigan scientist, studied the way in which the high, warm currents from the tropics are sucked down as though through a gigantic ventilating shaft, cooled, and hurled back again toward the equator in the form of hurricanes." In the shifting air above this dome of perpetual ice, answers to many meteorological mysteries are hidden. When Greenland, and other key points to the north, are manned by year-around observers, the birth of storms and shifting weather can be reported and increasingly accurate long-range predictions made.

Already, striking results have been obtained in the prediction of weather by analyzing moving air currents. For four years, the California Institute of Technology and the Massachusetts Institute of Technology have been cooperating in classifying American air currents. By countless recordings they have identified eight types of air that flow across the United States from tropical and polar regions. Each has its distinctive combination of physical properties. By identifying the air masses, and by knowing the direction they are moving, the experts can predict just what will happen when they meet, exactly as a chemist knows what will happen when two chemicals are poured into the same solution.

Applying this method of weather prediction, Irving Krick, twenty-seven-year-old aviation meteorologist, reports he has been able to reach a record of ninety-six percent accuracy in his forecasts. As a result, one air-line is said to have stepped up its completed flight schedules forty-five percent during the past year and to have saved $55,000 in operating expenses.

On every flight as the pilot climbs for altitude he reports the temperature at each thousand feet. Coming in by radio, these reports give a vertical cross section of the air and enable the weather experts to Continued on page 92

Hoop, revolving against its forward motion, demonstrates the movement of air currents in the development of a thunderstorm

As a jet of air will hold aloft a light ball, so rising currents of warm air suspend ice particles which, when heavy, fall as hail

Moist air, carried slowly into a cold area, produces snow, but if it is whirled up at express speed the cold will freeze it to hail

A deck quoit not only whirls but also moves forward. The flat wheel of a hurricane does this too, turning about a calm center

Movement of Storm-Forming Air Currents

Nature Invented

By Robert E. Martin

BRICKS MADE BY INSECT

Ages before man made bricks, a tiny water species here knew how to make bricks and lay them to raise a chimney. Like this one

WHEN during the World War clouds of poison gas were first let loose as weapons, most people thought that this was entirely new. But long before man learned to make the crudest of flint axes, nature had equipped a considerable number of her creatures for chemical warfare!

If you wish to see an example, you should literally leave no stone unturned particularly in slightly damp places. Sooner or later you will be rewarded by hearing a distinct "pop" and by seeing a tiny cloud of bluish smoke float away from the vicinity of a small beetle. If he had been annoyed by some one of his natural enemies, the cloud of noxious gas would have served as a protection allowing him to make his escape while the enemy was temporarily out of commission. This habit of gassing those who interfere with him has won the beetle the title of Bombardier.

Some species of ants are equipped with acid-throwing apparatus! When attacked they elevate their heads, and project from their mouths a jet of formic acid which may be sent as far as five inches.

If you were asked to name one invention that man can claim as his very own, you might feel perfectly safe in saying, the bow and arrow, the gun, any weapon that throws a projectile. But you would be wrong, for nature devised its principle ages before man discovered how to kill birds by throwing stones.

Many plants, and some animals, use projectiles. Perhaps the most startling example is furnished by the hunting gun used by a fish found in India called Toxotes jaculator. His principal food is supplied by the insects that wander over the leaves of plants near the water's edge. The fish cannot, however, leap out after them, so he decides to shoot them, just as the hunter shoots game at long range.

The Toxotes draws up water and cor-

rating his mouth, projects it with so much force and certainty that he rarely fails to hit the insect aimed at.

It was only within the last half-century that the hypodermic syringe was invented to inject a small amount of pain-deadening drug into the blood.

Nature made this invention long before man did, but she filled her hypodermic needles with poison as a means of defense for some of her creatures.

The poison fangs of the rattler, cobra, and other poisonous serpents operate exactly as does the hypodermic syringe.

Bees, wasps, mosquitoes, and some ants are also provided with hypodermic needles filled with poison which, fatal when injected into other insects, is a painful annoyance to man. These devices differ slightly in construction from the serpent's tooth, for the insect's sting makes its wound by the rapid movement of tiny lancets, working in the tube through which the poison flows.

Although nature anticipated so many of our devices, it is seldom that man has secured an invention directly from one of nature's patterns. This, however, did occur in building Crystal Palace in London—the first of the all steel-and-glass buildings that are now commonly used for factories and railroad sheds.

A vast building was required for the exhibition of 1851 and not an architect was able to supply a plan to which there was not some objection. Suddenly Joseph Paxton, a gardener, produced a rough plan of a building on a totally new principle. He had studied the enormous leaves of the Victoria regia, the great water plant of which one leaf will support a fair-sized child, and had discovered the secret of the leaf's supporting power.

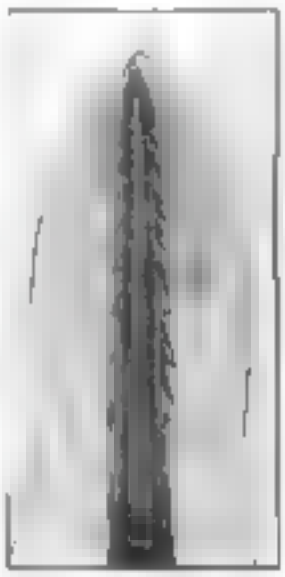
Paxton simply copied in steel girders the arrangement of the ribs of the round lily pads, added the familiar glass panes of his garden nursery frames, and the Crystal Palace was created. In recognition of his originality, the obscure gardener became Sir Joseph Paxton and an eminent citizen.

BEES USE THE HOOK AND EYE

A microscope will show you on the wings of a bee hooks and eyes like those man invented. The eyes are a groove and the hooks in a row on edge of wing

NATURE'S FIRST TRAP

Man uses a trap to catch animals but the trap was first used by a plant as is shown in circle



HYPODERMIC NEEDLE

With this needle doctors inject drugs into patients. But its principle is found in the sting of a honey bee, the construction of which the photo shows

Them FIRST!

Man's Ingenuity at Building, Fighting, or Capturing Food Is Matched by the Instinctive Skill of Plant or Animal

EGGS ARE PLANTED

Much as man plants corn with the old-fash oned hand planter grasshoppers dig a hole in the earth and deposit a sack containing as many as 6,000 eggs. Above, the locust digging the hole for its eggs with the tool seen at far left

Every one knows how much cooler the broiling summer day becomes after a sudden thunderstorm, and the student of physics knows that the heat has been used up in vaporizing some of the water that falls as rain, thus cooling the air. Some substances, like ammonia and carbonic acid, use up more heat in being evaporated than does water, thus producing a greater cooling effect, and in recent years man has made use of this fact to produce artificial ice.

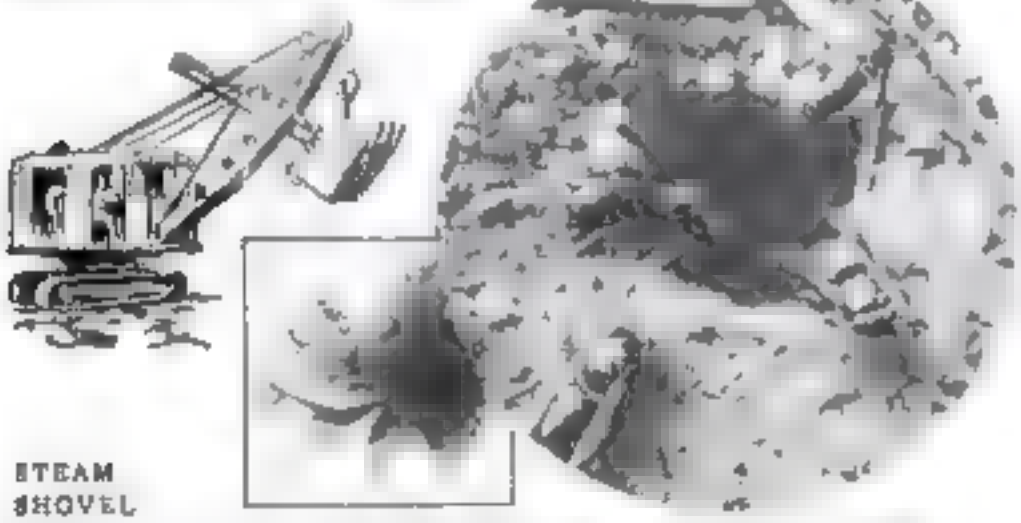
Yet long ago nature utilized the effect of evaporating carbonic acid and water for the benefit of the arboreal of India. This tree climber is often exposed to long droughts. It therefore makes use of a cooling apparatus to obtain water from the air.

Some of its leaves are strangely jug-shaped. From the stem a long, many branched root extends down into the jug's bottom. The inside surface of the jug exudes water and carbonic acid. As this cooling mixture evaporates, the temperature in the jug is lowered, and in consequence the moisture of the air collects upon the root inside, just as drops of water collect upon a pitcher of ice-water. This moisture runs down into the jug's bottom, and is in turn drawn up into the plant for its own use.

It would not be news to anybody that the industrious beaver invented the mud dam, but perhaps it is not so well known that he also dug the first canal ever used for water transportation. It was cut across low, level ground toward the nearest standing trees, which the beaver then cut and floated along the canal for use in dam building or as food logs.

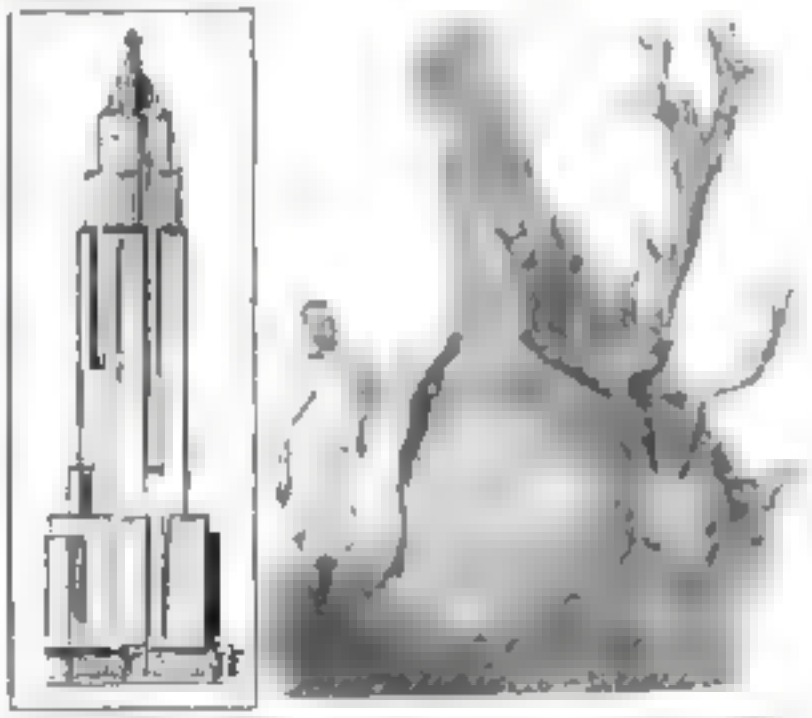
Human engineers are rightly proud of the Panama Canal, but it is really no more wonderful than some of the waterways constructed by beaver engineers. Ernest Thompson Seton writes of one that he observed in the Adirondack Mountains of New York, which was six hundred and fifty-four feet long, two or three feet wide, and two feet deep.

The dam for which the beaver is famous is a no less astonishing feat, for it is a solid mass of branches and mud which may be twenty feet wide, twelve feet high and as much as twelve hundred feet long. This (Continued on page 104.)



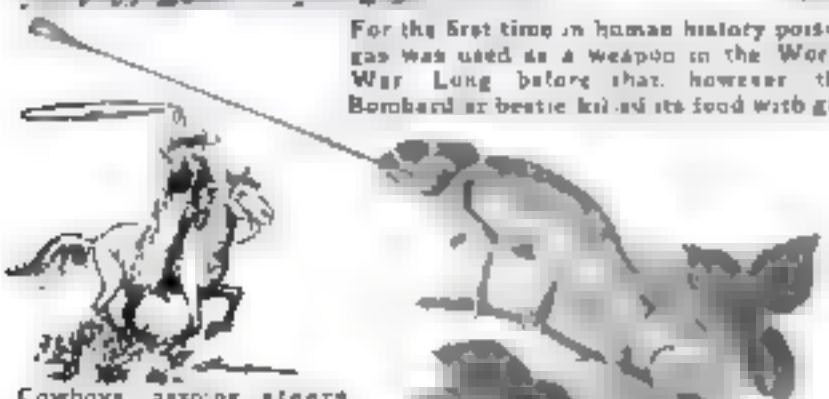
STEAM SHOVEL

Man is proud of his steam shovels that move dirt with great rapidity but countless centuries ago the mole cricket did its digging and burrowing seen in photos above, with its own shovel in just the same way



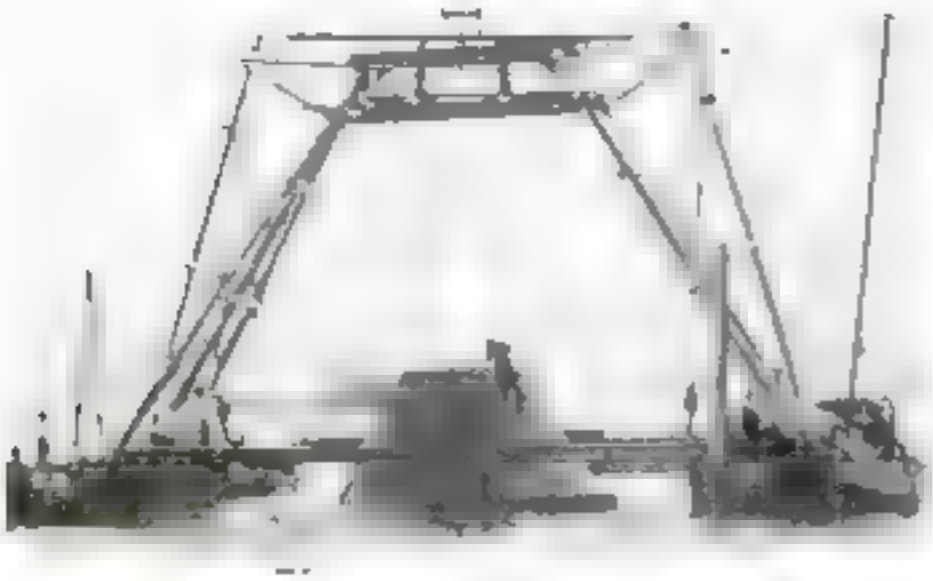
Man's tallest skyscraper is 200 times his own height, or 200 feet tall. Termites build enormous structures that are more than 300 times their height, like the big one pictured above

For the first time in human history poison gas was used as a weapon in the World War. Long before that, however, the Bombardier beetle killed its food with gas

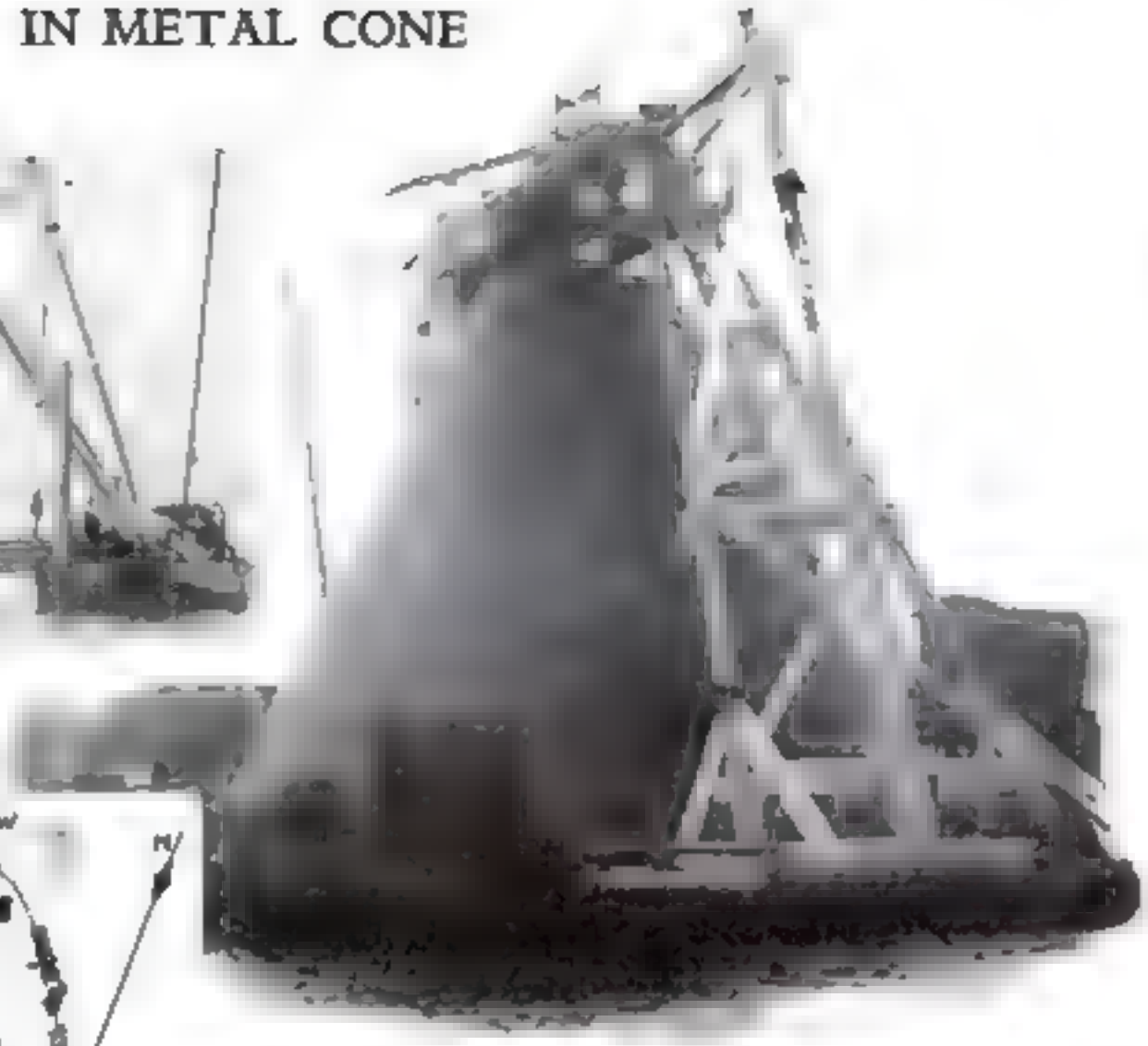


Cowboys roping steers are no more skillful than are chameleons who spear their prey with the tongue

HUNT SHIP'S GOLD IN METAL CONE



Lowering a giant cone above a sunken ship from which divers will try to raise $10,000,000 in gold



Above is the huge dome inside which divers will work in an effort to recover a sunken fortune. At extreme left, the *Lutine* as she looked at time of sinking. Arrow in drawing shows location of gold room. No. 1 is iron ballast, 2, cannonballs, 3, a mast, 4, anchors put down in 1857 and 5 is broken wreckage

Within a giant metal cone that serves the dual purpose of diving bell and caisson salvagers have begun a thrilling attempt to recover $10,000,000 in gold from the sunken British frigate *Lutine*, which foundered off the Dutch coast more than 100 years ago. Now it lies covered by fifteen feet of water and forty feet more of quicksand. Shielded by the conical dome, the salvagers plan to sink a shaft through the quicksand to the vessel's treasure room.

ENVELOPE SEALER FOR USE IN THE HOME

Only two motions are required to close an envelope with a new moistener and sealer designed especially for home use which enables personal mail to be handled as it is in an office. A stroke to the right as shown above, with the flap between a felt pad and a water barrel, moistens the glue and a return stroke seals the flap. One filling of the water reservoir is said to be sufficient for sealing securely and rapidly as many as 1,800 envelopes

BIG MAP SHOWS WHERE GERMANS LIVE

Meanderings of the German people about the globe are strikingly portrayed in an unusual exhibit prepared by government officials. Tiny human figures have been distributed upon a large map of the world each figure representing a unit of German population. While the exhibit strikingly

TELESCOPE CAMERA MAKES MOVIE OF WILD BIRDS

POWER PENCIL MAKES DESIGN

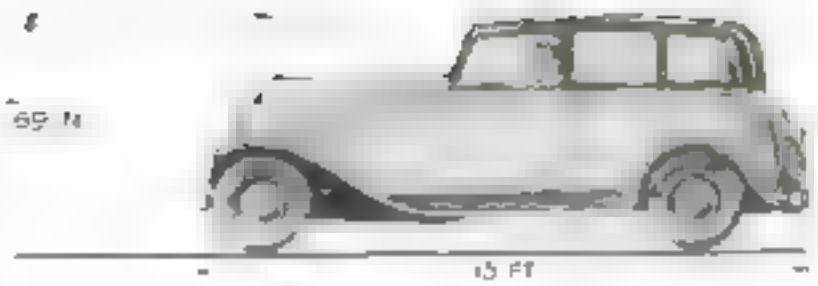
HANDLED as easily as a pencil, a miniature electric perforator recently placed on the market enables an amateur to create artistic, perforated designs on paper. The sheet is laid upon a desk blotter and the design is then drawn upon it with the vibrating electric needle, which may be manipulated free-hand or guided along the outlines of a tracing. The tool is especially useful in preparing mimeograph stencils for schools or offices, as it executes the most intricate drawings without danger of tearing the stencil or causing undecipherable blurs on the copies.

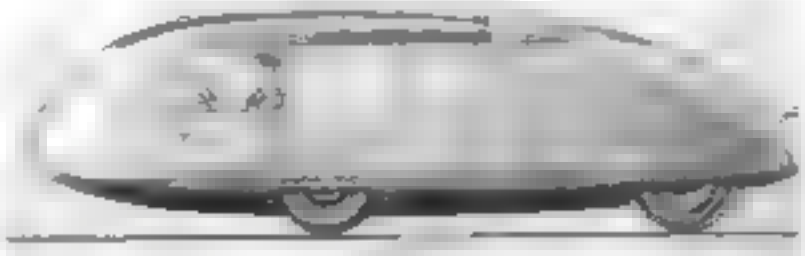
SUIT HANGERS IN NEW TRAVELING BAG

For motorists and others with whom luggage space is at a premium, a new type of traveling bag has been designed. Folded double, it may be grasped by the two handles and carried in the hand like a valise. Extended full length, it may be hung on a hotel door or car door as at right, or laid flat beneath a berth on a train or ship. Hangers are provided for three suits, while pockets hold shirts, shoes, and all other articles needed on even an extended automobile trip.

NEW THREE-WHEEL AUTO MEETS ITS FIRST TEST ON HIGHWAY

VIEWED by its Bridgeport, Conn., designers as the car of the future a three-wheeled vehicle of radical appearance recently received its first public demonstration. Though only four feet longer than the average American automobile, its streamlined body contains nearly three times as much useful space for passengers and luggage, and at normal driving speeds the new car is said to require only one-fifth as much power. The single rear wheel steers the car, enabling it to turn completely around within its own length by pivoting on the front wheels. A rear-view periscope is mounted on the top, while an air scoop ventilates the motor at the back.





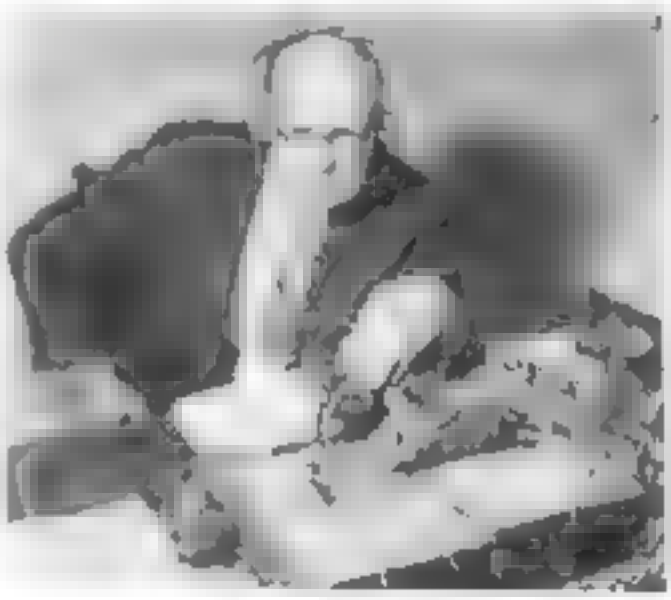
New three-wheeled, streamlined car compared in height and length with a conventional model. At left, the car and its designers. Note periscope on the roof and the ventilator for motor's radiator at the rear

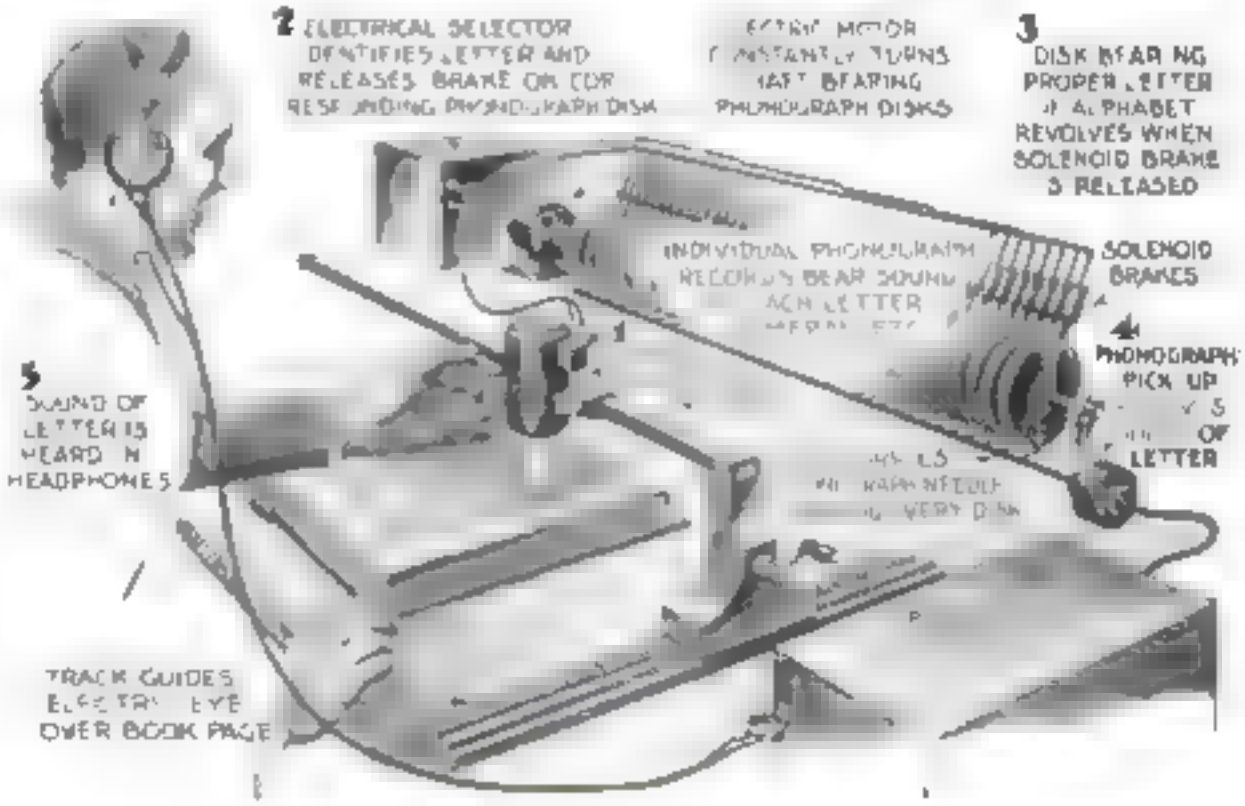
BURNING WOOL GIVES OFF POISON GASES

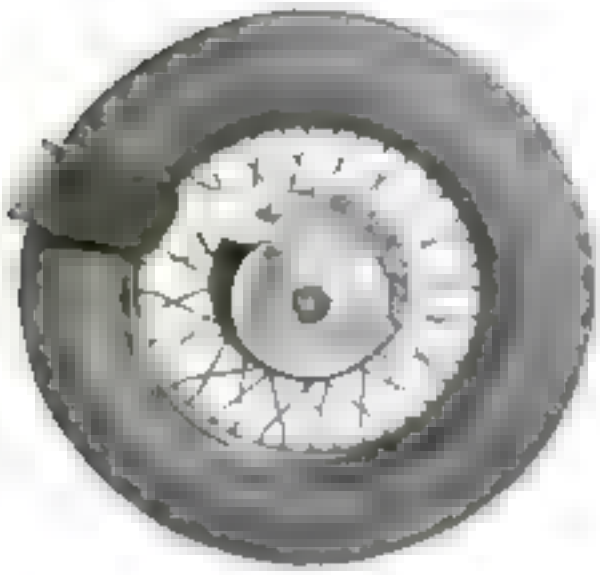
BURNING woolens emit poison gases, tests carried on in the asbestos-lined room of an eastern laboratory have recently disclosed. In fires, woolen carpets, clothes, draperies and upholstery give off many fumes including carbon monoxide, carbon dioxide, hydrogen sulphide, hydrocyanic acid and ammonia. Researches showed where the gases were thickest in a fire.

MACHINE READS BOOK ALOUD TO BLIND

MAKING a book read itself aloud is the startling achievement of Glenn Watson, Detroit, Mich., inventor with the experimental apparatus pictured at right. When commercially perfected, it is expected to make the text of any book available to the blind. Each letter of the printed alphabet, Watson has found, reflects a slightly different amount of light from any other, and this difference is detected and identified by the use of an electric eye. Through relays a corresponding phonograph record is automatically actuated as shown in the diagram below. The listener hears the words spelled out.







PUMP ON BRAKE DRUM KEEPS AIR IN TIRES

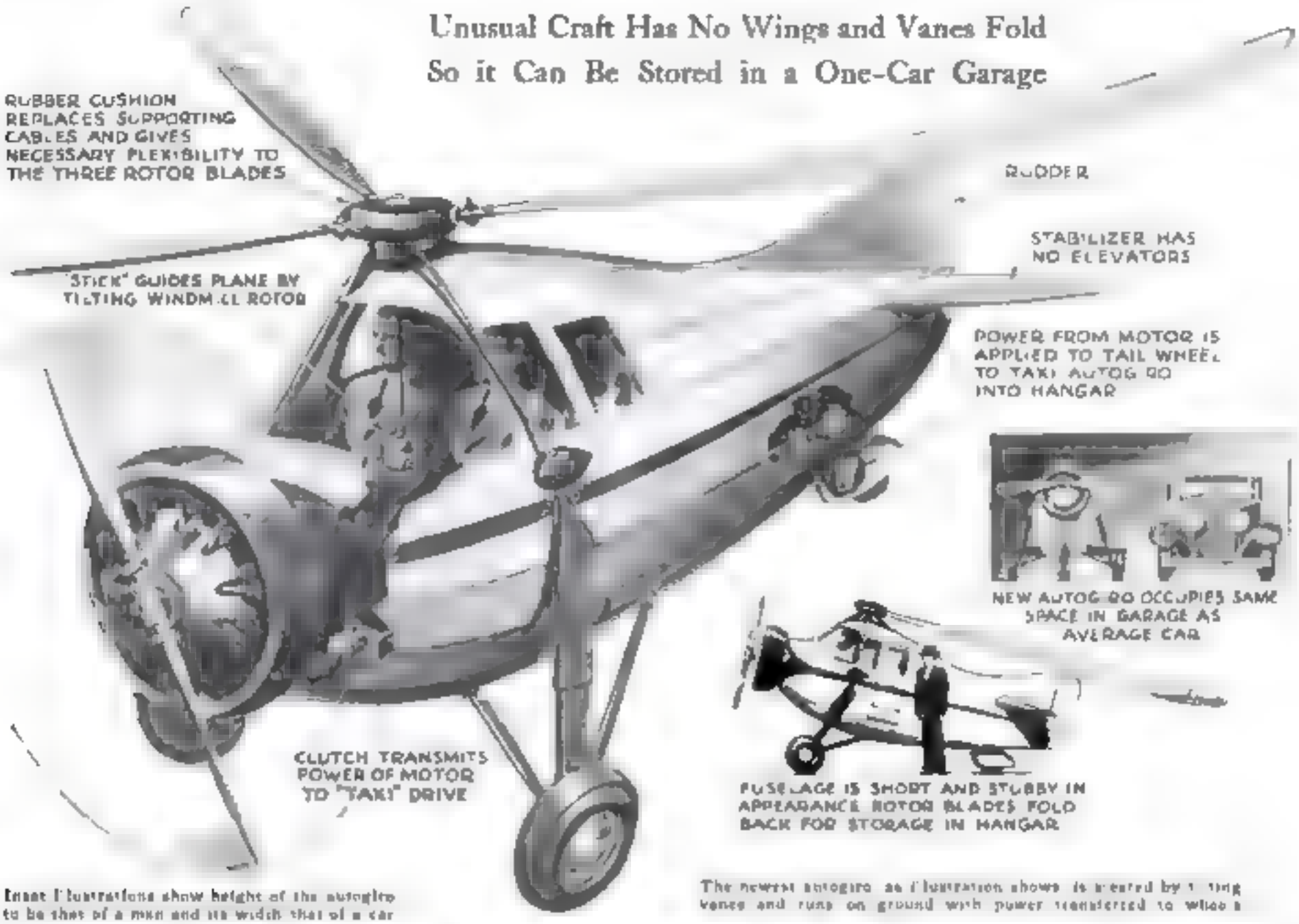
TIRES are automatically kept at the proper pressure, as long as a car is running, by a set of miniature pumps recently introduced. One of these devices, illustrated above, is installed on the brake drum of each wheel, and is operated by a cam on the stationary part of the brake. At each revolution, a spring plunger is released, forcing air into the tire until the correct pressure is attained. Then the spring tension is insufficient to add more air and over-pumping is automatically prevented.

FISH CARRIES ITS BAIT

A FISH that carries its own bait for luring smaller fish within its reach is among the rare specimens brought back from tropical waters by Dr. William Beebe, noted explorer. The bait is a long tentacle, dangling in front of the fish's mouth, so that it can gobble up the smaller fry that come to investigate the waving object.

Tilting Rotor Steers New Autogiro

Unusual Craft Has No Wings and Vanes Fold So it Can Be Stored in a One-Car Garage



Inset illustrations show height of the autogiro to be that of a man and its width that of a car

The newest autogiro, as illustration shows, is steered by tilting vanes and runs on ground with power transferred to wheels

One overhead handle in the cabin of the latest type of autogiro now being successfully tested at Willow Grove, Pa., enables the pilot to steer up, down, or sideways and to bank the craft simply by tilting the windmill-like rotor. The experimental model carries a horizontal rudder but tests indicate that this may be superfluous. There are no ailerons or elevators and the stub wing usually present in this type of craft is missing. Because of the simplicity of control the new craft is expected to be especially suited to the novice pilot and is soon to be marketed. Other striking innovations are embodied in the new machine. A clutch disconnects the motor from the propeller and transfers the power to a tail wheel, steered from the cabin so that the plane can run out of its hangar under its own power. The vanes fold out of the way when the plane is parked so it occupies no more space than an auto. It has a top speed of 105 miles an hour.

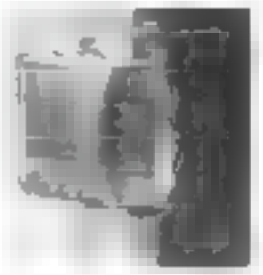
RAISED NUMBERS BAFFLE CAR THIEVES

Raised pattern of engine's number makes it hard for auto thieves to alter the figures

To guard the engine number of a car from alteration by thieves, a check-protector system has been devised. The engine block bears a raised pattern of letters or symbols, similar to those used on checks to prevent check-raising, and the figures of the serial number are stamped directly upon this panel as illustrated. The number cannot be erased or changed without defacing the raised symbols, and the evidence of fraud would be so obvious as to brand the car as stolen.

LATCH BOLT OILS ITSELF

A new latch bolt for doors lubricates itself. The metal contains an oil-impregnated inlay of wood, eliminating friction on both flat and beveled sides.



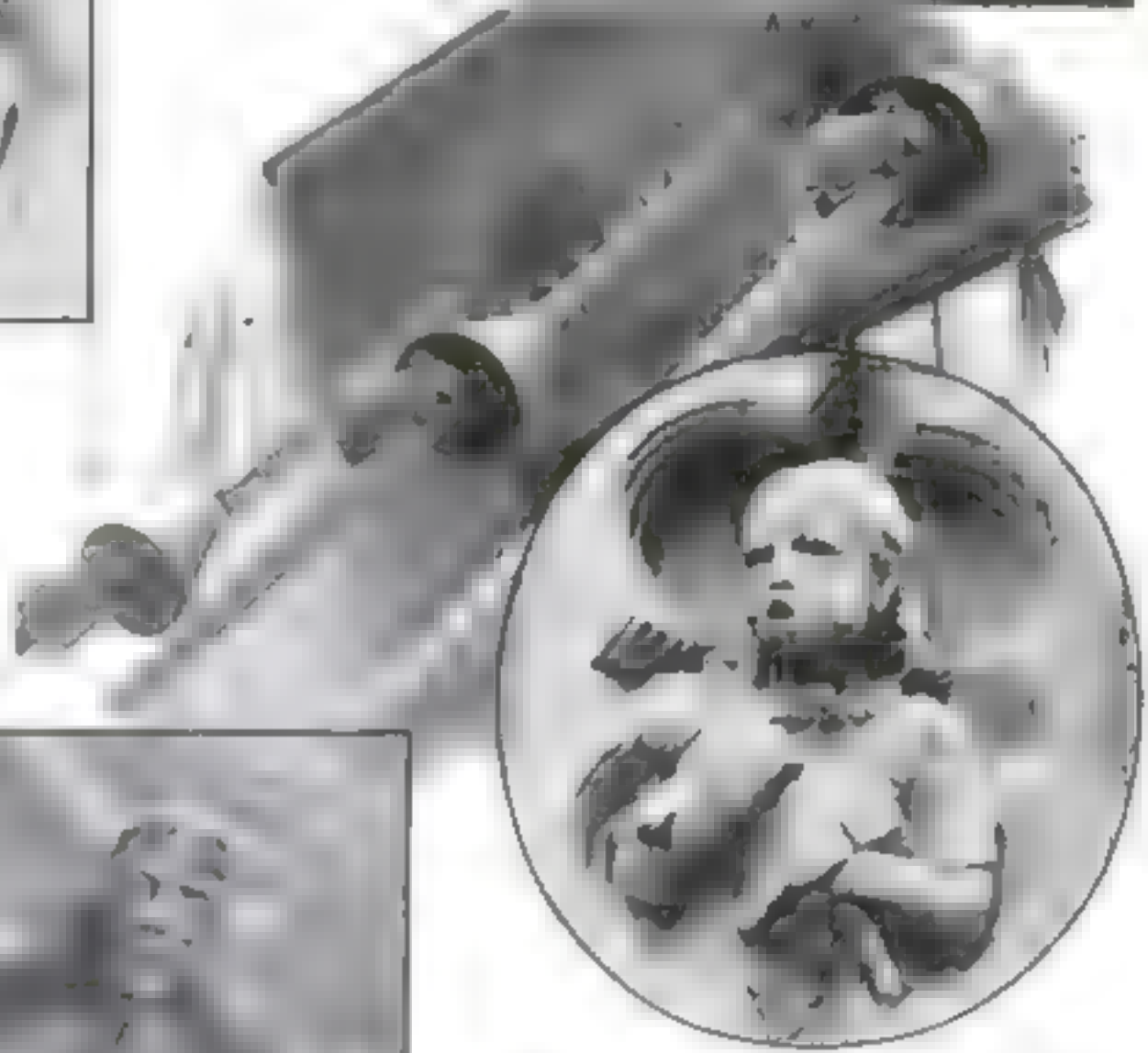
CIGARETTE LIGHTED BY GLOW

No larger than a woman's lipstick, a new mystery cigarette lighter works without flame or electricity. The smoker simply holds his cigarette against the porous top and inhales several times and this lights the smoke. The secret is that a blended fuel containing methyl alcohol is thus drawn through a porous pill containing platinum. Catalytic action, similar to that of platinum gas-stove lighters, causes the pill to glow and light the cigarette. Wind cannot interfere with the use of the lighter, which works if a cotton pad is kept saturated with fuel.

Grotesque Figures Carved

On one of New York City's most modern skyscrapers appears the carved figure of this jolly fisherman. No one seems to know the meaning of it, nor why it is there

This iceman, right, holding a stingy piece of ice in his tongs, may be seen over the entrance of an exclusive Park Avenue apartment building. To make the meaning clearer the figure is pouring ice and around his lips is a smile suggestive of many things



The supports of the aluminum canopy of an office building suggested ship's hawsers to the sculptor so he added climbing rats and shields to keep them from lowering the ship

What purpose does this singing girl, with her doll, serve, perched high up in a New York skyscraper?

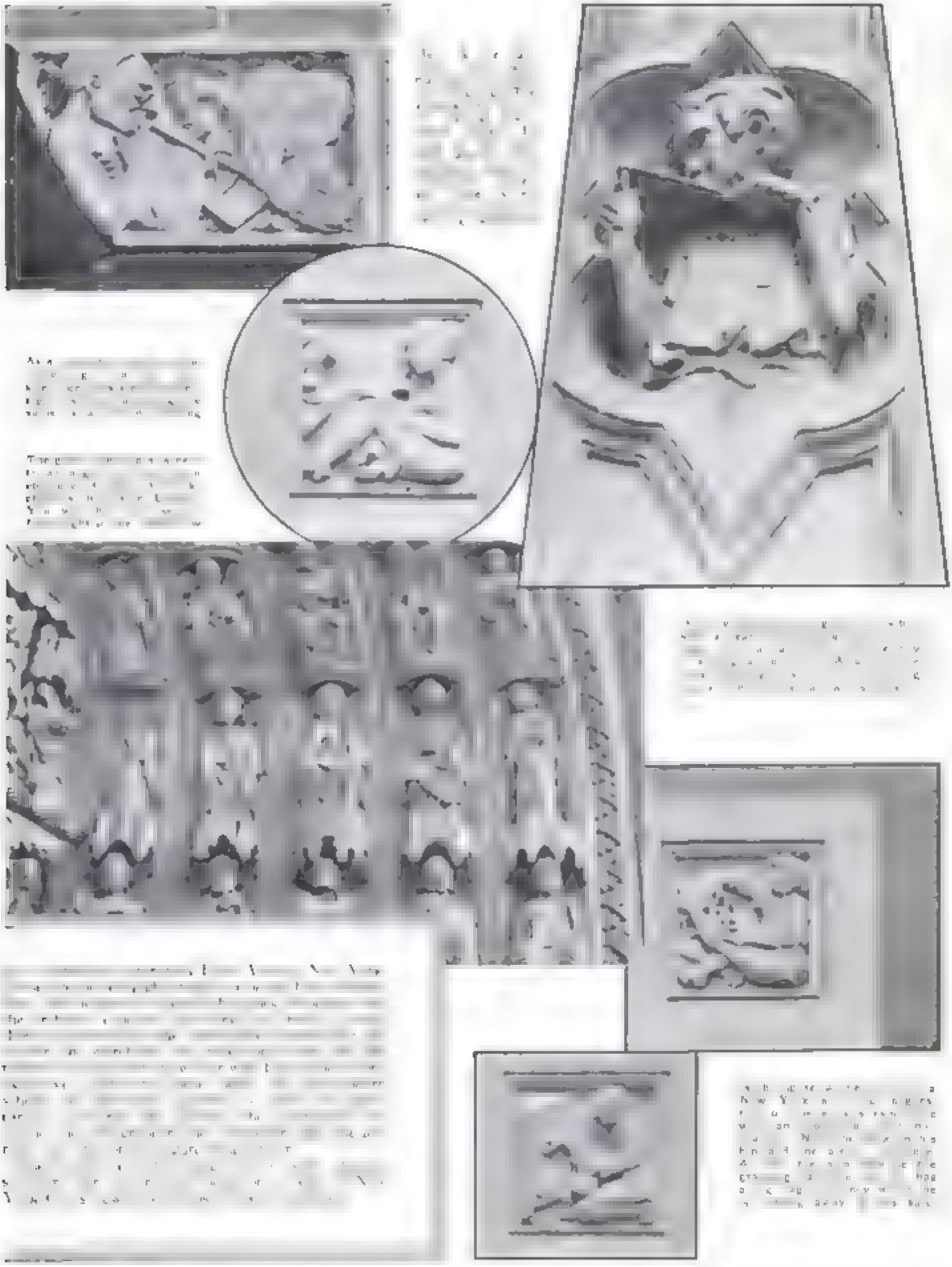
Under the main entrance to a fashionable Fifth Avenue church have been carved tiny heads, supposed to represent the types to be found in the congregation. Some are believed to be good natured caricatures of prominent members of the church

The modern girl, right, with a cigarette and a cane, is found perched on the fourth floor of a New York building in a niche where no one was told to place her

A boy with a shooter, a long fisherman, rats climbing up hawsers are among the strange objects that be found upon modern skyscrapers or apartment houses. Thousands of people have passed through the buildings thus adorned without ever having seen these figures, or if seen there was no recognition of their purpose. Sometimes the architect has played a joke upon the unsuspecting owner, installing a queer figure in so inaccessible a place that only a person with a telescope could examine it. In other cases, the figures have a real, if unconventional, symbolism and are, in a way, the modern equivalents of the gargoyles and statues of medieval architecture

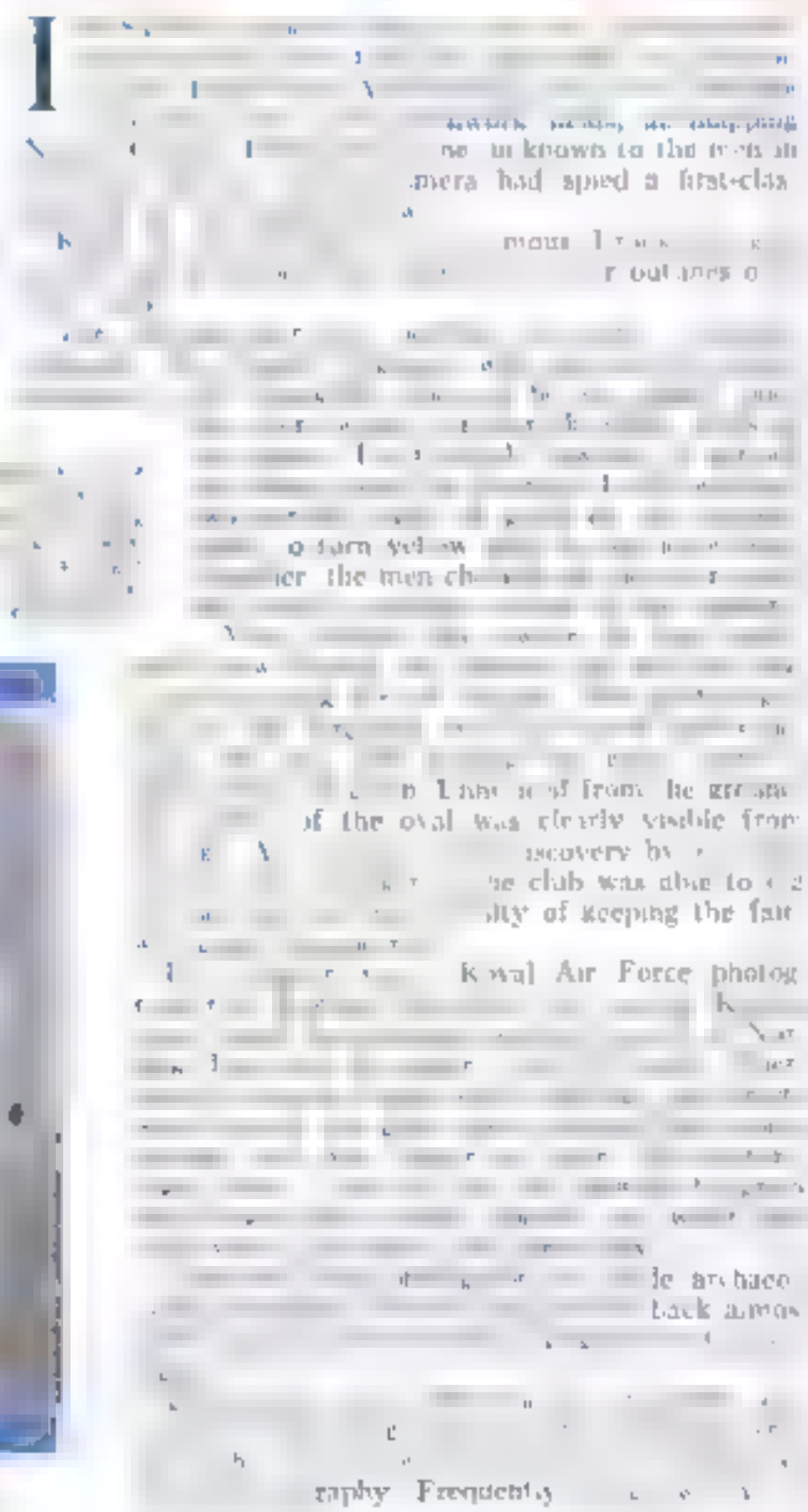
A whimsical architect is said to be responsible for a group of figures in the ceiling of the main entrance

on Modern Skyscrapers



High-Flying Cameras

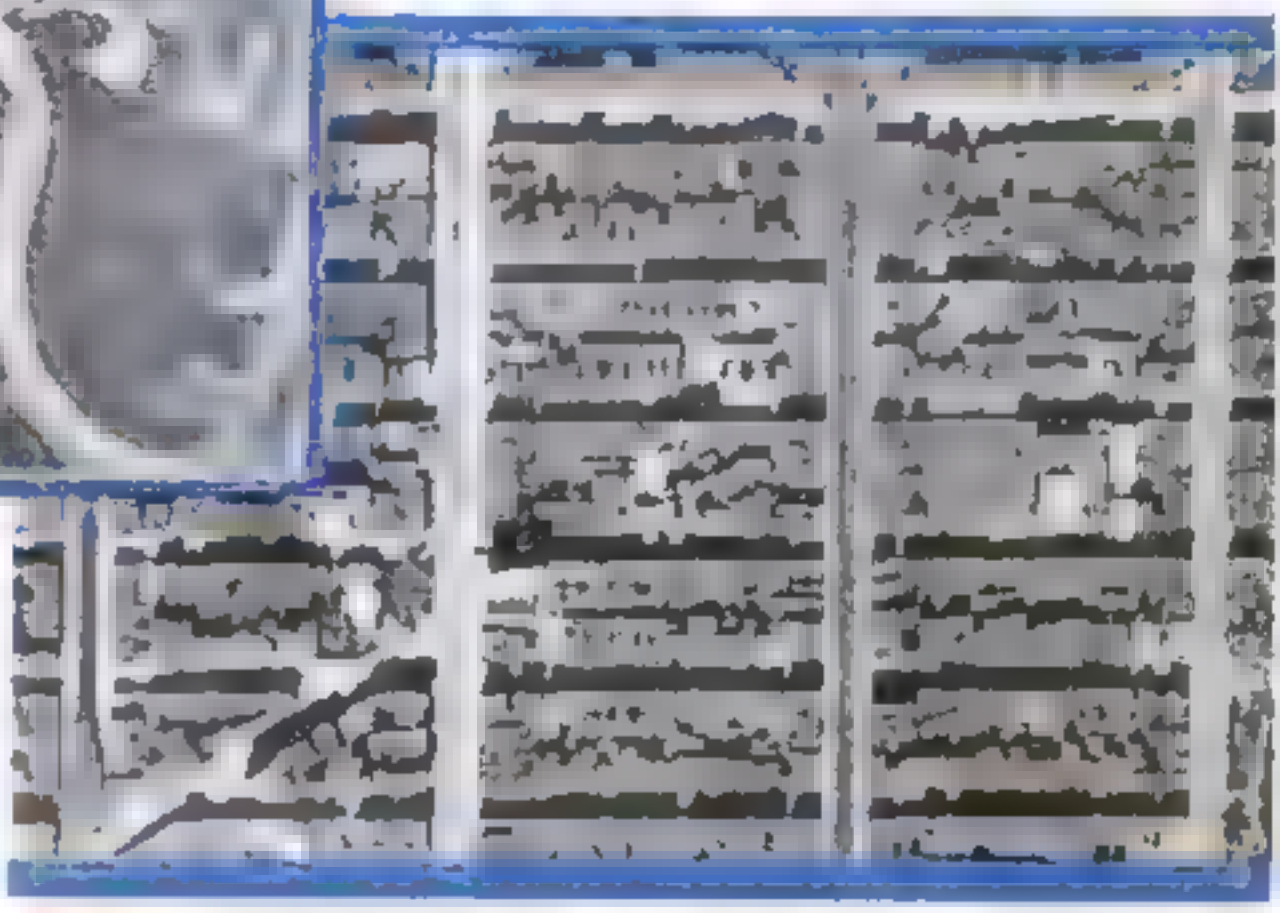
UNCOVER MYSTERIES OF LAND AND SEA



Sunken City Found and Prehistoric Art Discovered by Photos Made from Planes

By ***EDWIN TEALE***

RIVER CHANGED ITS COURSE Air view of a Mississippi tributary shows old loops reclaiming from an abandoned channel and now marked by strange shaped lakes found by camera



LOST ROAD IN HEART OF CITY A picture taken above New York with a high-flying air camera showed the Old Fitzroy Road, the start of which is seen, lower left. Its course is marked by buildings that stand at irregular angles to the streets. It was lost until this picture rediscovered it

overlooked or impossible to see on the ground are visible to the camera eye from a great height.

Talk to the men who ride the photographic planes, listen to them swap yarns about the surprises they get when they develop their film, and you learn of the queer, surprising things their cameras see on the ground below.

Not long ago a Fairchild Aerial Surveys plane was droning through the sky over the swamps and sand plains of the North Carolina-South Carolina border, mapping the territory for a lumber company. Capt. Robert A. Smith, the photographer, was busy with his camera. The pilot flew with his eyes glued to the instruments. So they were both surprised later on by the curious formations recorded on the ribbon of developed film. Hundreds of depressions which looked like the oval tracks of prehistoric monsters clustered together in one section of Horry County, S. C. They ranged in length from fifty feet to two miles.

What were they? How had they been formed? Various answers were given to explain the mystery. Finally Dr. F. A. Melton, University of Oklahoma geologist, studied the pictures, visited the region, examined the depressions, and then before a meeting of the American Association for the Advancement of Science, suggested the startling theory that the tracks are scars left by a collision with a comet!

Between 100,000 and 1,000,000 years ago, Dr. Melton believes, the earth collided with a cluster of meteors a third again as large as Halley's comet. Flying fragments, in this catastrophe of long ago, struck the earth in the region where the Carolina "bays" are found and the 1,500 oval depressions are the impact-marks they made. Other scientists have disputed this hypothesis and offered theories of their own. So the mystery spied by the flying camera remains unsolved.

Another picture, taken from the air, is giving archaeologists an enigma to puzzle over.

In 1932 the members of the Shippee-Johnson Expedition returned from their aerial explorations in the wild, little-known interior of Peru. They brought back pictures of volcanic peaks in valleys that have never been mapped; of unnamed glaciers high among the Andes, of the Great Wall of Peru, a crumbling barricade comparable with the Great Wall of China, which had never been heard of before. Built by some forgotten people long before the days of the Incas, this wall winds over the foothills of the Andes, dipping into tangled ravines, climbing over ridges, writhing across valleys, for more than fifty miles. Only on wings could the explorers reach its location or map its length.

It is not this wall, however, that puzzles the archaeologists. It is another picture showing a curious ribbon of pockmarks running along the backbone of a wild mountain ridge. A closer view reveals that each pockmark is a hole dug in the face of the rock. A dozen holes wide, the strip runs like a narrow section of honeycomb for miles along the ridge.

What is it? What is the secret of these miles of holes carved with infinite labor from the solid rock? Nobody knows. The wild terrane made a landing and close inspection impossible. The literature of the country makes no mention of the mystery. A dozen archaeologists and experts upon the customs of ancient peoples have examined the pictures and hazarded guesses as to their meaning.

One believes the holes are excavated graves from which the mummies have been removed. Another advances the interesting theory that the depressions in the rock are post holes in which some ancient race erected great vertical timbers, as a farmer plants fence posts, to form a wooden barricade against an enemy. Whether either of these theories is correct, remains to be proved. At present, the ribbon of pockmarks must be added to the list of unsolved enigmas sighted from the air.

Sometimes, a mystery seen from the sky is cleared up in short order. Such was the case on Long Island, a few months ago, when a low-flying plane put detectives hot on the trail of a gang of murderers. The machine was heading for Roosevelt Field in a long glide when the pilot caught sight of a crumpled figure lying in some bushes beside a highway. Noting the exact position of the body, he opened his engine and raced for the airport where he reported his discovery.

A few minutes later, he was leading the police to the spot. The murdered man, whose corpse was hidden from the road but easily seen from the air, was identified as the victim of gangsters. The quick discovery of the body gave the officers a running start in trailing the slayers, who were tracked down and placed under arrest in less than forty-eight hours.

You probably remember the excitement caused some years ago, by an aerial picture of the Hudson River taken near New York City. It showed a mysterious object, looking like a submarine, lying on the bed of the stream. Was it a foreign under-water boat? The U. S. Navy sent men to investigate. Was it a rum-running submarine? The prohibition enforcement officers hurried to find out. At Mitchel Field a government plane took off and circled over the river. But the submarine was gone.

In the meantime, the photographer had been doing a little investigating of his own. It led him to an embarrassing discovery. A defect in the mechanism, he found, had caused the camera to jam, taking two pictures on the same film, one of a boat, the other of the empty river. The composite photograph showed the dim outlines of the vessel lying on the river-bed far below the rippling surface of the water. With this discovery, the great submarine mystery came to a sudden end!

In another case, something unexpected happened in an aerial camera half a mile above the Statue of Liberty and caused considerable excitement.

It was at the time when a new type camera, having a Venturi tube sucking the film tight against the top of the dark chamber, was being introduced. When the aerial shot of New York Harbor was developed, the amazed photographer beheld

Photo by Air Map[illegible] of America

This air picture shows clearly the outline of a race track stretching across the fairways of a Long Island golf club. Unseen from below, difference in grass color revealed its presence.

parallel rows of Morse Code dots and dashes running across the negative. He was even more bewildered when he saw that opposite the Statue of Liberty they formed two words, man and eat!

Where had they come from? How had they got on the film? What did they mean? He was unable to explain them. He thought of everything from the wireless operators on ships in the harbor to messages from Mars. The film remained a nine-day puzzle until tests revealed the curious solution.

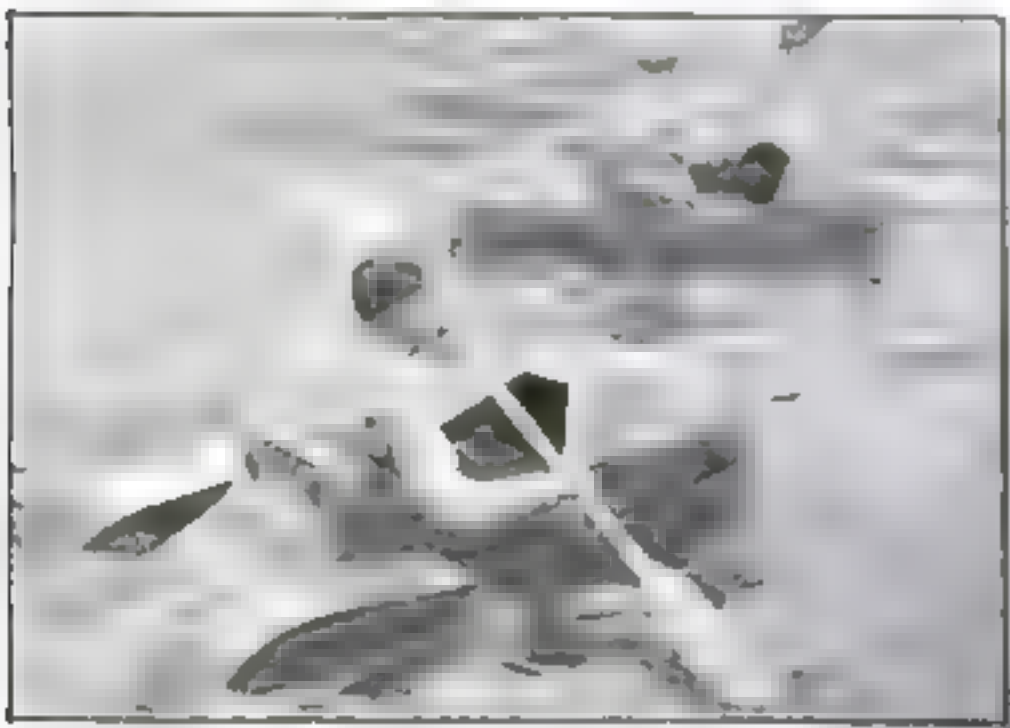
On clear, cold days, they showed static electricity in the new camera skipped across the face of the film, leaving a white trail of dots and dashes. The forming of the two three-letter words had been accidental. The reason the photographer did not recognize the marks as those of static electricity was because his only experience was with pressure plate cameras in which the sparks always left forked or jagged imprints suggesting the swamp marks on topographic maps. In recent years, graphite rollers and other improvements have practically eliminated the wandering sparks from both the pressure plate and the Venturi tube cameras.

The opposite of these experiences, an instance in which an air-photo mystery seemed due to defective equipment but was not, is found in the files of the Airmap Corporation of America.

At 6,000 feet, one of their photographers made a vertical shot of the Aviation Country Club, at Hicksville, L. I. On all sides, it showed the wide expanse of the level Hempstead Plain. The negative, when the film was developed, had a curious dappled appearance. All over the picture were strange ripplelike variations in color. The cameraman thought something had been wrong with his developer. But the real explanation, as he learned later, went back 50,000 years to the time when the last glacier of the Ice Age was retreating northward.

At the edge of its melting ice, wavy deposits of gravel were left behind. Wherever these stony deposits are found, the soil is less rich and (Continued on page 100)

MOTOR CYCLE'S SIDE CAR USED AS A BOAT



[illegible]

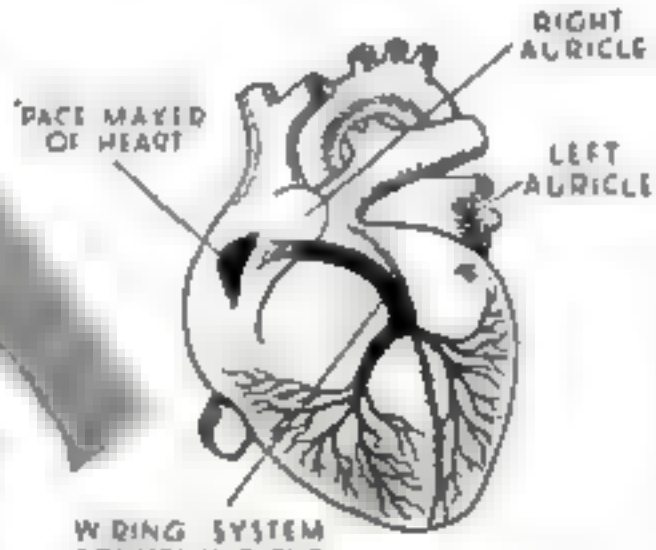
When a German motor cycle of new [illegible] of a lake or river the s[illegible] fitted with pontoons so th[illegible] craft is propelled by a double-ended [illegible] A few minutes work is sufficient to attach it to the cycle or [illegible] away. Designed for military use, the amphibi[illegible] recently tested successfully near Berlin in prep[illegible] forthcoming use in army maneuvers.

When the human heart is stopped by any accident, the new self-starter is used as is shown in this picture. Here the needle is being inserted by one of its inventors, C

PHYSICIAN INVENTS

SELF-STARTER for Dead Man's Heart

An insulated wire passes through the hollow center of the needle to complete the circuit



WIRING SYSTEM CONVEYING THE ELECTRIC IMPULSES FROM PACE-MAKER TO THE HEART MUSCLES.

WHAT can be done when the heart ceases to beat? Under all sorts of different conditions, a doctor often is confronted with this urgent question.

The ambulance physician faces it with the victim of heart stroke, drowning, or accident. The surgeon faces it when the pulse of an etherized patient suddenly stops. The family physician faces it when a baby is still born or when a mother's heart stops during childbirth.

Until recently the only answer was the injection of a powerful stimulant into the heart itself, with the result that, not infrequently, the heart failed to respond.

A new answer has just been furnished by the invention of Dr. Albert S. Hyman, heart specialist of the Beth David Hospital of New York, and by C. Henry Hyman, electrical research engineer.

Each needle is kept in a sterilized test tube. Diagram of heart shows position of pacemaker

This life-saving device can be compared with the self-starter of a car. When the car's engine stalls, the starter motor turns it over until the cylinders are again firing. In the same way, when the heart stops under any of the conditions named above, the needle of the "Hyman Otor," as it is called, gives the four-cylinder heart engine a rhythmical electrical stimulation. This starts the heart beat and maintains it until the heart's own "electric generator" resumes operation.

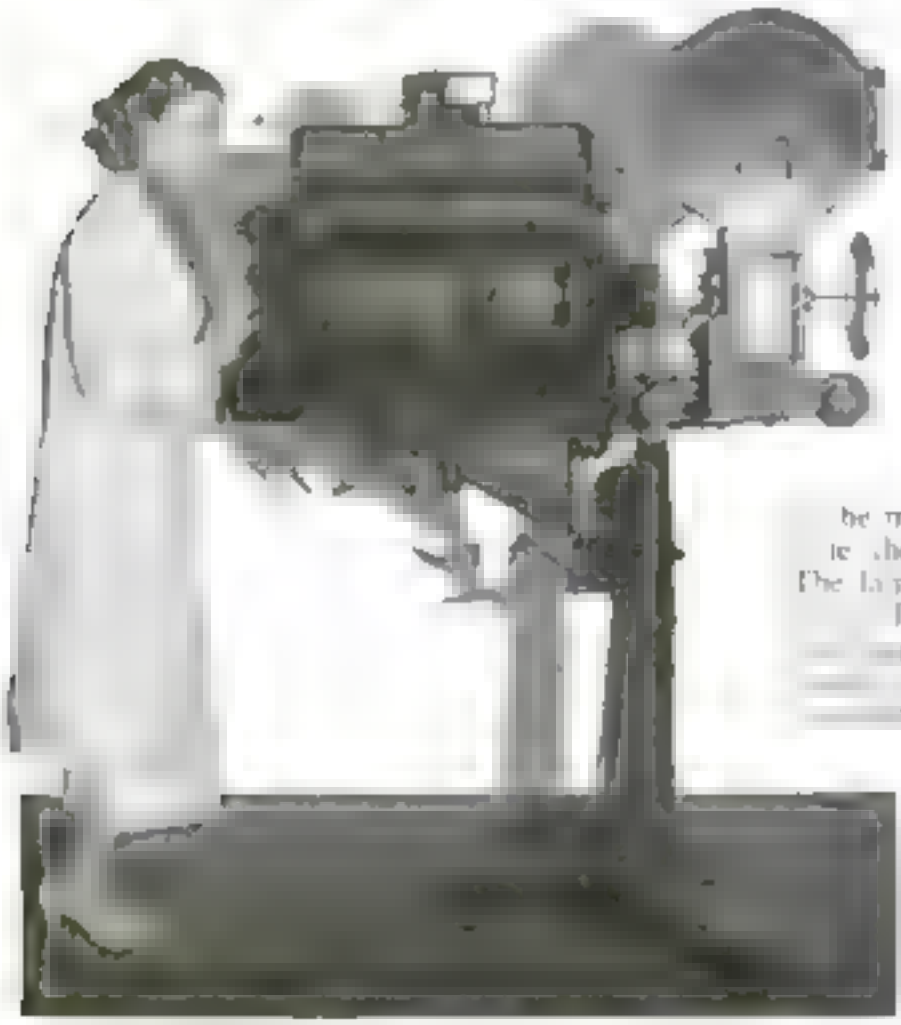
This comparison is not far-fetched, for the equivalent of an electrical generator exists in the wall of the right upper chamber (or auricle) of the heart, and a system of "wires" conveys the electrical impulses to the heart muscle. This "ignition system" is called the "pace-maker" of the heart.

The essential feature of the Hyman invention is a hollow steel needle, through which a carefully insulated wire runs to the open point. Both the needle itself and its central wire are connected to the terminals of a light, spring-driven generator, provided with a current-interrupting device. This mechanism can be adjusted to give electrical impulses with the frequency of the heart-beat from infancy to old age.

When the physician faces a case of heart stoppage, he inserts the needle between the first and second ribs into the right auricle of the heart, and starts the generator at the required frequency. The rhythmical current then "cranks" the heart engine by stimulating the "pace-maker" to act in step with the generator until its normal action is resumed. Usually this occurs quickly.

Medical authorities predict a wide usefulness for the "Hyman Otor."

NEW PROJECTOR DOUBLES MOVIE LIGHT



A NEW type of projector for throwing motion pictures on a theater screen is said by its Hollywood, Calif., inventor to provide twice as much illumination as standard types using the same amount of current. In consequence its use is expected to give better quality and added brilliance to movies, and to make possible the use of larger screens. The lamp employs an improved [illegible] alternating-current arc [illegible] its current from the [illegible] lighting mains through a [illegible]

An alternating current arc in the new projector for motion picture theaters [illegible] is said to double the illumination now provided by standard types. It is expected to make possible the use of a larger movie screen

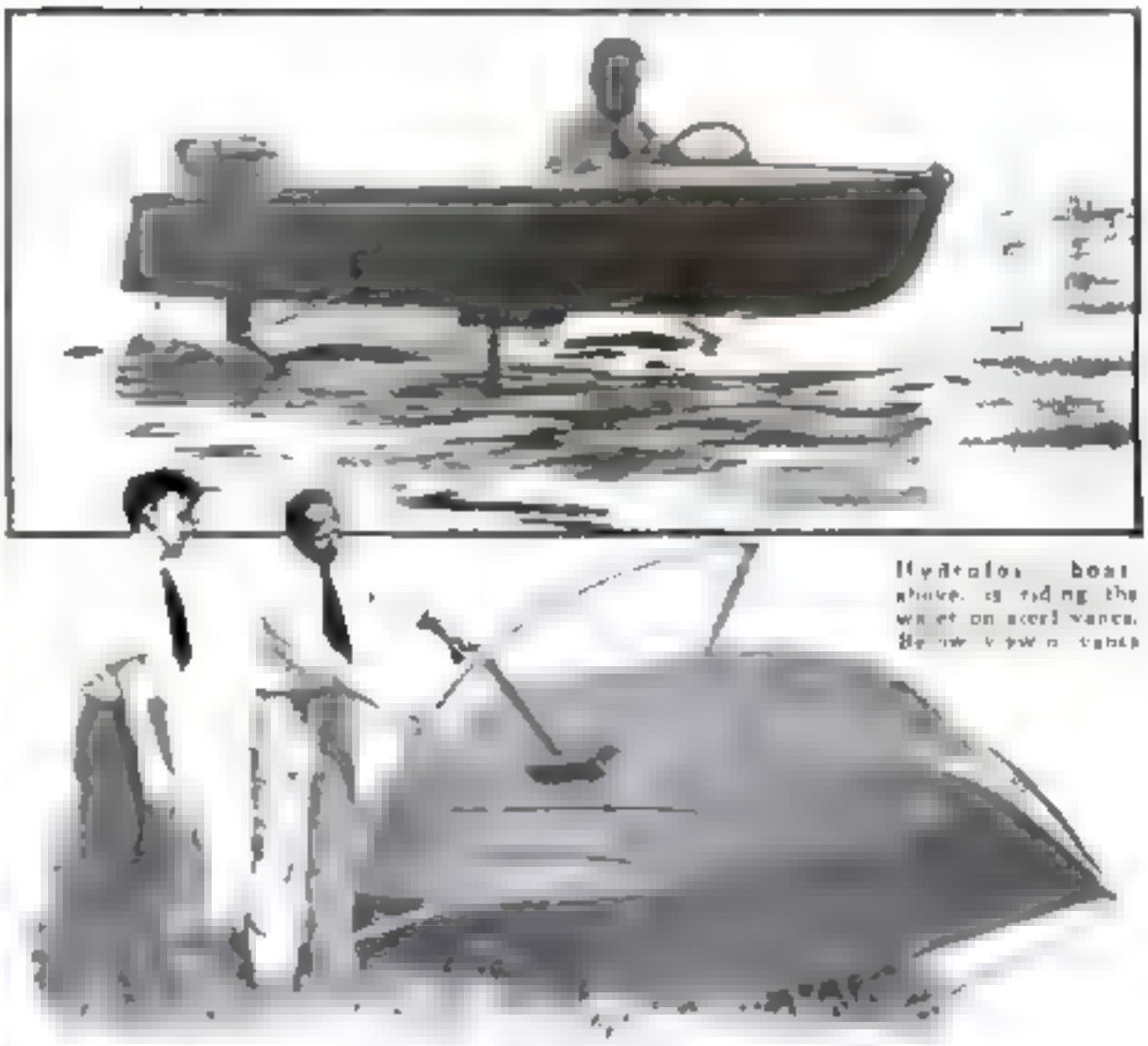
TOILET KIT FOR AUTO HOLDS WATER AND SOAP

CAUGHT with an unexpected puncture or repair job, a motorist need not arrive at his destination with grimy hands. His tool chest holds a newly-invented wash kit. Its inner container holds enough water for a quick scrub, while the surface of the container itself is a cake of molded soap. The whole is enclosed in a metal case to be slipped under a seat or in a side pocket. When the soap is used up, a refill may be placed around the water container, which thus is practically everlasting.

MINIATURE PILE DRIVER SINKS FENCE POSTS

SETTING up fence posts has become a safer job since engineers of the Pennsylvania Department of Highways devised a miniature pile driver designed especially for the operation. Handled by two men it dispenses with the use of a sledge hammer with attendant danger to workman from flying chips or a misplaced blow and also avoids "mushrooming" the tops of the posts. The heavy cylindrical device slips over the post and is repeatedly hoisted and dropped by its projecting handles.

Two men easily drive metal fence post into the ground with this recently designed pile driver

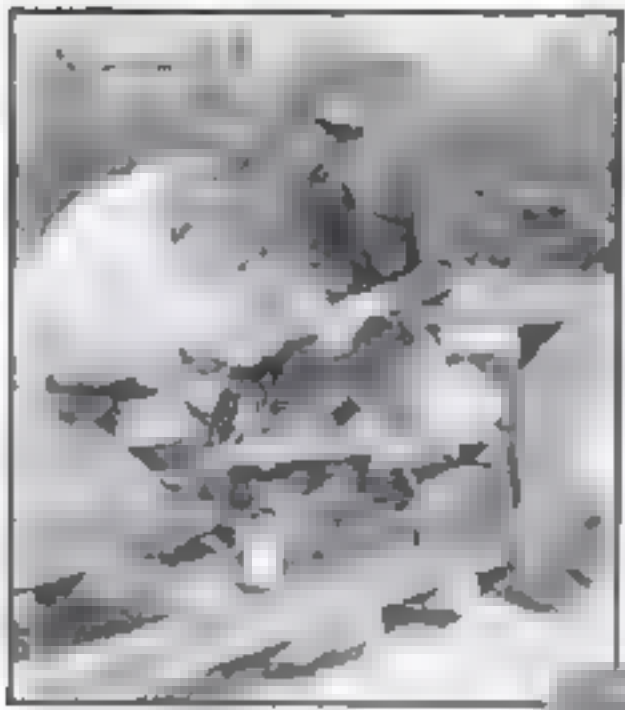


Hydrofoil boat above, is riding the water on steel vanes. Below, view in cabin

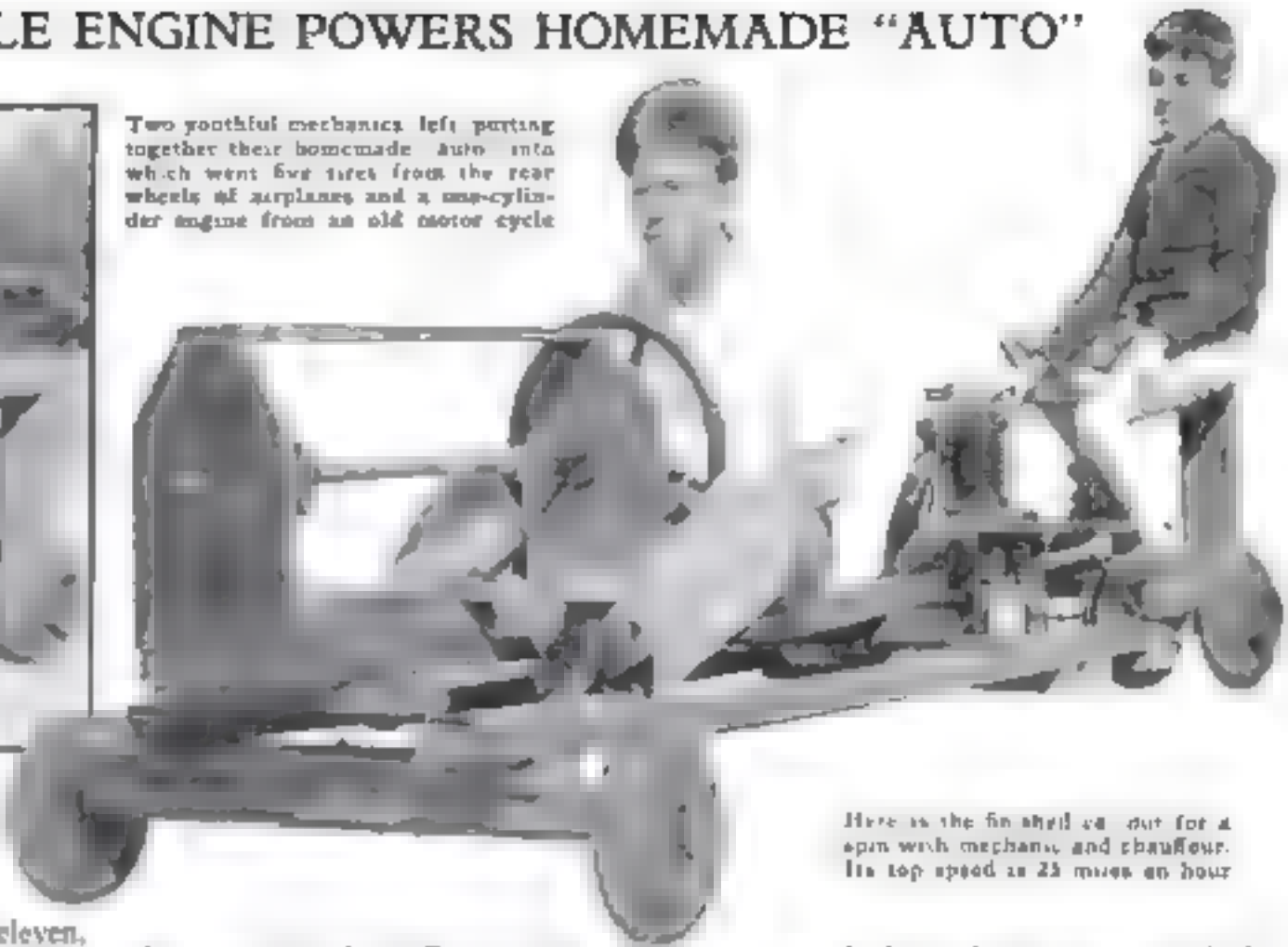
SPEEDBOAT RUNS ON STEEL VANES

How the speed of motorboats may be doubled without increasing their power was demonstrated in spectacular fashion at Philadelphia, Pa., the other day, when Dr. Oskar G. Tietjens, Westinghouse research engineer, demonstrated the first full-sized model of his "hydrofoil" speedboat. Thin steel vanes, or hydrofoils, set beneath the craft, lifted its hull entirely clear of the water at full speed, and the absence of fluid friction permitted the boat to skim the water with amazing velocity. The lifting effect of the vanes in water is similar to that of an airplane's wings in air. The new boat is the outcome of successful experiments which Dr. Tietjens conducted with models last year (P. S. M., Sept., '32, p. 11).

MOTOR CYCLE ENGINE POWERS HOMEMADE "AUTO"



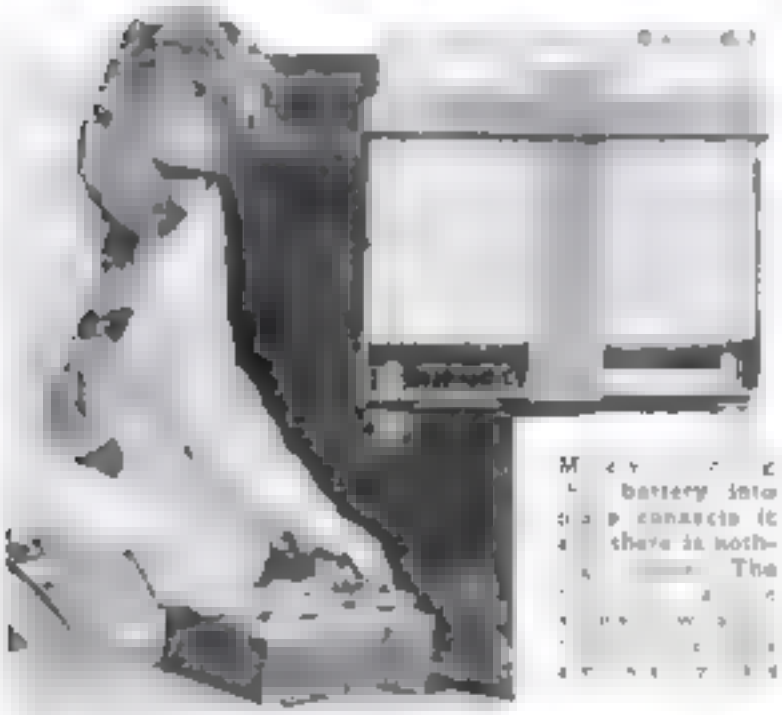
Two youthful mechanics left putting together their homemade auto into which went five tires from the rear wheels of airplanes and a one-cylinder engine from an old motor cycle



Here is the finished car out for a spin with mechanic and chauffeur. Its top speed is 25 miles an hour

Five airplane tail-wheel tires, some two-by-fours and an old single-cylinder motor cycle engine were converted into an up-to-date roaster wagon by Bill Jahant eleven, and Johnny Beery thirteen of Akron, Ohio. The fifth wheel mounted on the rear axle is used to drive the vehicle. It is connected to the engine by a chain, running over sprockets. Steering is accomplished by an automobile steering wheel operating a shaft on which two cables are wound, the other ends of the cables being attached to the extremities of the front axle. The car's top speed is about twenty-five miles an hour and it uses very little gasoline.

CAR BATTERY IS SELF-CONNECTING



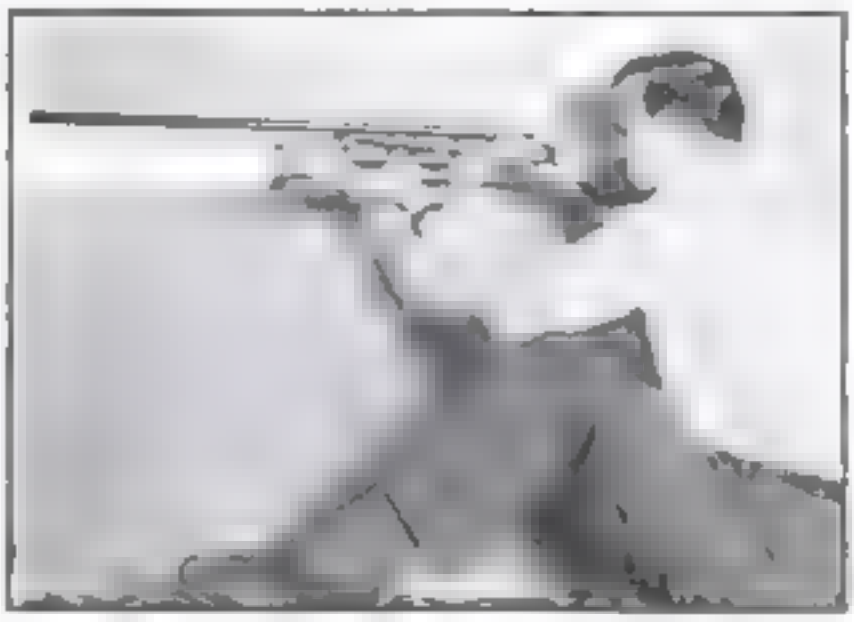
RELIEVING the owner of the nuisance of unscrewing or tightening cable terminals, a self-connecting storage battery for autos has been invented. Merely dropping the battery into its special hanger connects it. Built-in conductor bars run from the battery's two terminal posts to sockets on opposite corners of the base. The sockets engage a pair of connection posts on the bottom of the hangar, as the battery slides home. When in place, the battery rests with a clearance of one-sixteenth of an inch from the hangar bottom, its weight on the posts ensuring perfect electrical connection.

MITTEN HANDCUFFS SECURE CRIMINALS

ONLY the tips of fingers and thumbs protrude from handcuffs of a new style invented by a former member of the Canadian Mounted Police and shown above. Each of the metal gloves is hinged in two leaves equipped with locks. The mitten-shaped handcuffs were devised by the inventor in the belief that the ordinary type makes it possible for a desperate criminal, being transported overland, to attempt to grasp his captor's gun or attack him with the hands.

FLASH LIGHT ON BIG GUN

A FLASH LIGHT attachment for a big game gun is an unusual piece of equipment accompanying Captain R. Stuart Murray and Major George Witten on an expedition to Honduras, where they hope to bag specimens for the American Museum of Natural History. The five-cell focusing lamp is to be used in night hunting and will aid in drawing a bead on the blinded animal.



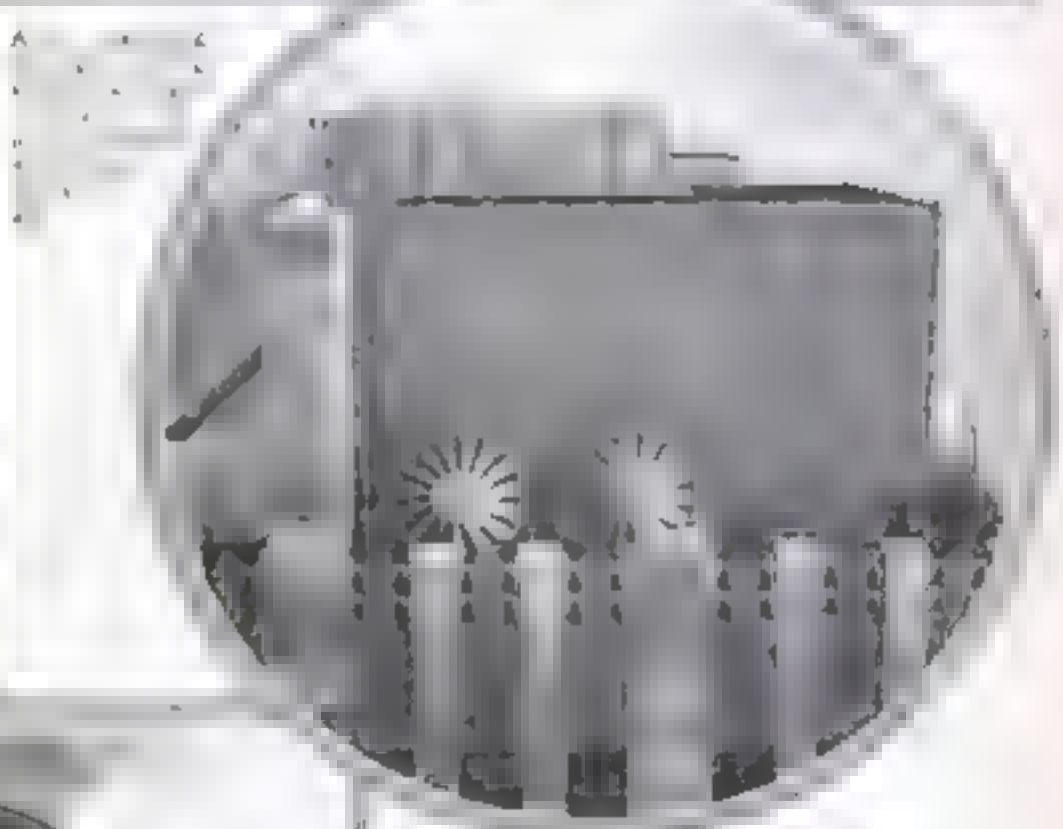
Powerful flash light attachment to be used in hunting at night

NOISE CAUSES LISPING

LISPING is caused by city noise. Stuttering is five times as common among men as among women. The nervous strain of the depression has increased the number of stammerers. These are some of the conclusions of recent investigations made at Brooklyn College, N. Y.

Deadly SMOKE Menace

ATTACKED ON WIDE FRONT



Cities Unite in Concerted Drive Against Air Laden with Health-Destroying Impurities

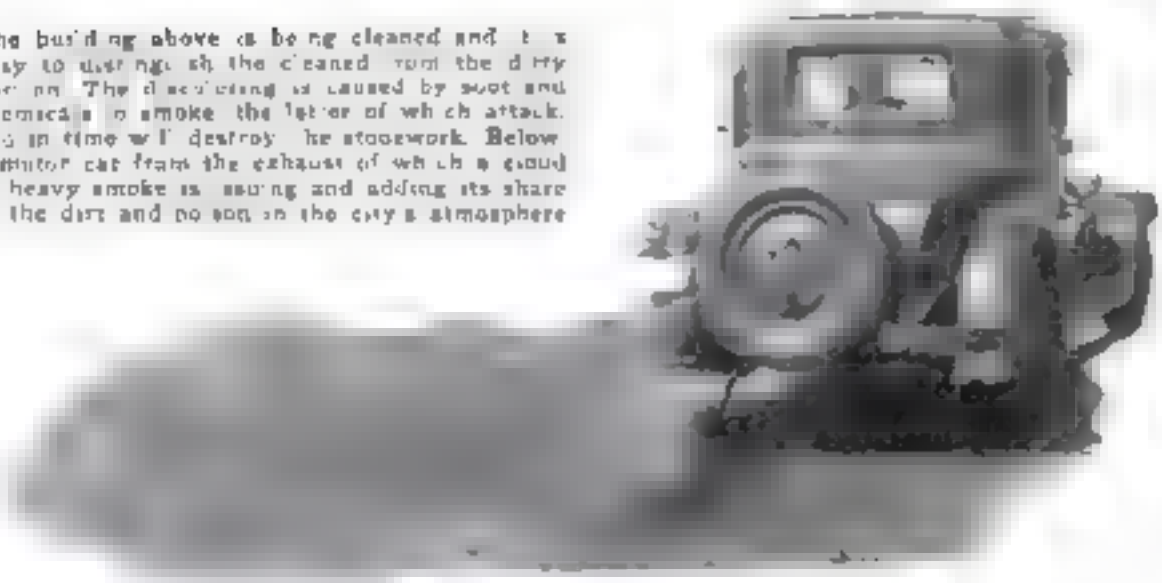
AWAKE at last to the menace of smoke as a destroyer of health and property, great cities of the United States have opened campaigns against it. Medical authorities now realize that an ever-increasing proportion of cases of respiratory diseases is directly traceable to smoke particles floating in city air. Their baneful effect does not end here; for, blanketing the sky, they form a curtain through which only a part of the ultraviolet rays can filter.

Attacking the stone of skyscrapers, the sulphurous fumes that belch from smokestacks eat into the stone and cause it eventually to crumble. Huge cleaning bills for clothes and buildings, in great industrial cities, are the result of volumes of smoke polluting the air. Sometimes its depredations take spectacular form. Thus a New York farmer's $3,000 crop of spinach was ruined by smoke from nearby factories.

Simply banishing preventable smoke, Henry Obermeyer New York public utilities official, states in his recently-published book, "Stop That Smoke!" will bring about the following benefits: reduction of the country's death rate by one-sixth, twenty to fifty percent more sunshine in cities; half a billion dollars' worth of property damage prevented annually and the country's fuel bill cut by one-fifth.

Plants attacked by gas from smoke are here being treated with a solution of liquid soap and dehydrated phosphate applied with a sponge

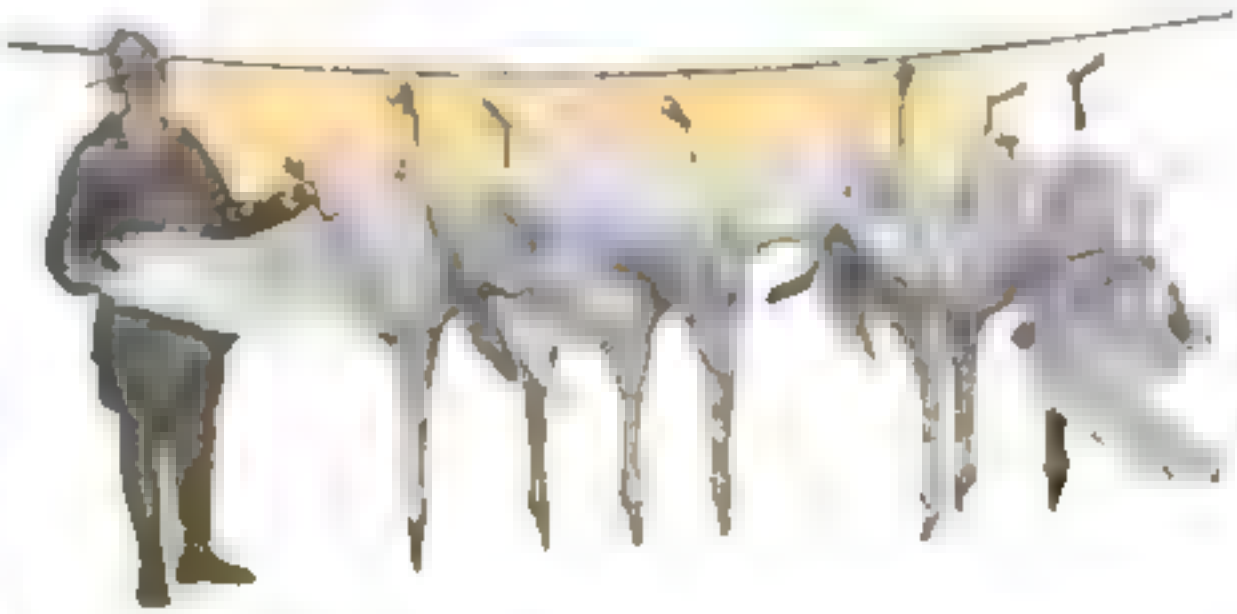
The building above is being cleaned and it is easy to distinguish the cleaned from the dirty portion. The discoloring is caused by soot and chemicals in smoke, the latter of which attack, and in time will destroy, the stonework. Below a motor car from the exhaust of which a good deal of heavy smoke is issuing and adding its share to the dirt and poison in the city's atmosphere



Tug boats are also smoke offenders, as this photo shows. Multiply the output of this stack by that of scores of others and you see how serious such contamination of the atmosphere is near big harbors

Special state laws permit the trapping of beaver if they are seriously injuring property. Poachers, taking advantage of these laws, are killing off the little animals, one of which is seen below

POACHING
MADE BIG BUSINESS
by Ruthless Gangs of Killers



HIDDEN among the P's of the dictionary, you find, "Poacher One who takes game or fish illegally." To this time-honored definition, recent events have given a new twist. Outlaws are invading the forests and exploiting the game resources of the country. Organized criminals are dealing in illegal furs, fake bounty scalps, out-of-season game birds.

The government's battle against this 1933-type poacher forms a thrilling and comparatively unknown story.

Under the direction of the U. S. Biological Survey, federal agents and game wardens are making a concerted, coast-to-coast drive. Already, fatal duels, attempts at ambush, running gun fights, have marked the struggle.

On the flats of the Sangamon River, in Illinois, recently, two United States game wardens, K. F. Roahen and M. A. Charlton, were cornered by duck-poachers and in an ensuing battle barely escaped with their lives. Hearing heavy shooting along the river, they had headed for the sound. As they were creeping through the woods, they stumbled on a case of shotgun shells and several sheep-lined overcoats. They had hardly stooped to examine them, when a gangster lookout, hidden behind a tree twenty-five yards away, fired both barrels of his shotgun. The sound brought the other poachers on the run.

Fighting Indian style, the wounded men dodged from tree to tree as the gang closed in. Flying shot tore through the leaves and thudded against the trunks around them. Charlton was bleeding badly from wounds in both arms, hips and one leg and Roahen had been hit in the stomach, face, and hands by the time they fought off their assailants and escaped. Weak from loss of blood, they had to tramp five miles to their boat, row across the river and then drive twenty-five miles by motor car before they could reach medical attention.

These big Whistling Swans were illegally killed on the Susquehanna River. The dead birds were seized when the poachers were arrested. The law prohibits the killing of these swans at all times for sport or profit

Soon after Roahen was released from the hospital, the ruthless gang sought to blow up his patrol boat while he was asleep on board, to wreck his automobile, and, subsequently, to murder him from ambuscade in revenge for his activity.

In Louisiana and in Iowa, other government agents were killed in cold blood by poaching gangsters. In Virginia, two out-of-the-season duck hunters fought a gun duel with federal agents that ended only when both poachers were killed. In Missouri, a U. S. game warden was attacked and seriously wounded from ambush and not far from Memphis, Tenn., another was shot at a dozen times with a high-powered rifle while he was examining a sandbar in the midst of the Mississippi River.

The game racketeers along the Mississippi and its tributaries, sell their bootleg birds to special dealers in Chicago, Ill. St. Louis, Mo., Cincinnati, O., Detroit Mich., Cleveland, O., and other midwestern cities. From $6 to $10 a pair is the price paid by hotels, restaurants, and clubs for such out-of-the-season delicacies. One ramification of the activity of a notorious Chicago liquor ring is reported to have been the large-scale disposal of wild game during closed seasons. High-speed trucks often transport the birds from the shooting ground to the ice-boxes of the crooked dealers.

Wolf scalps, buried by bounty crooks, are being dug up following their discovery by the wardens

By

George H. Dacy

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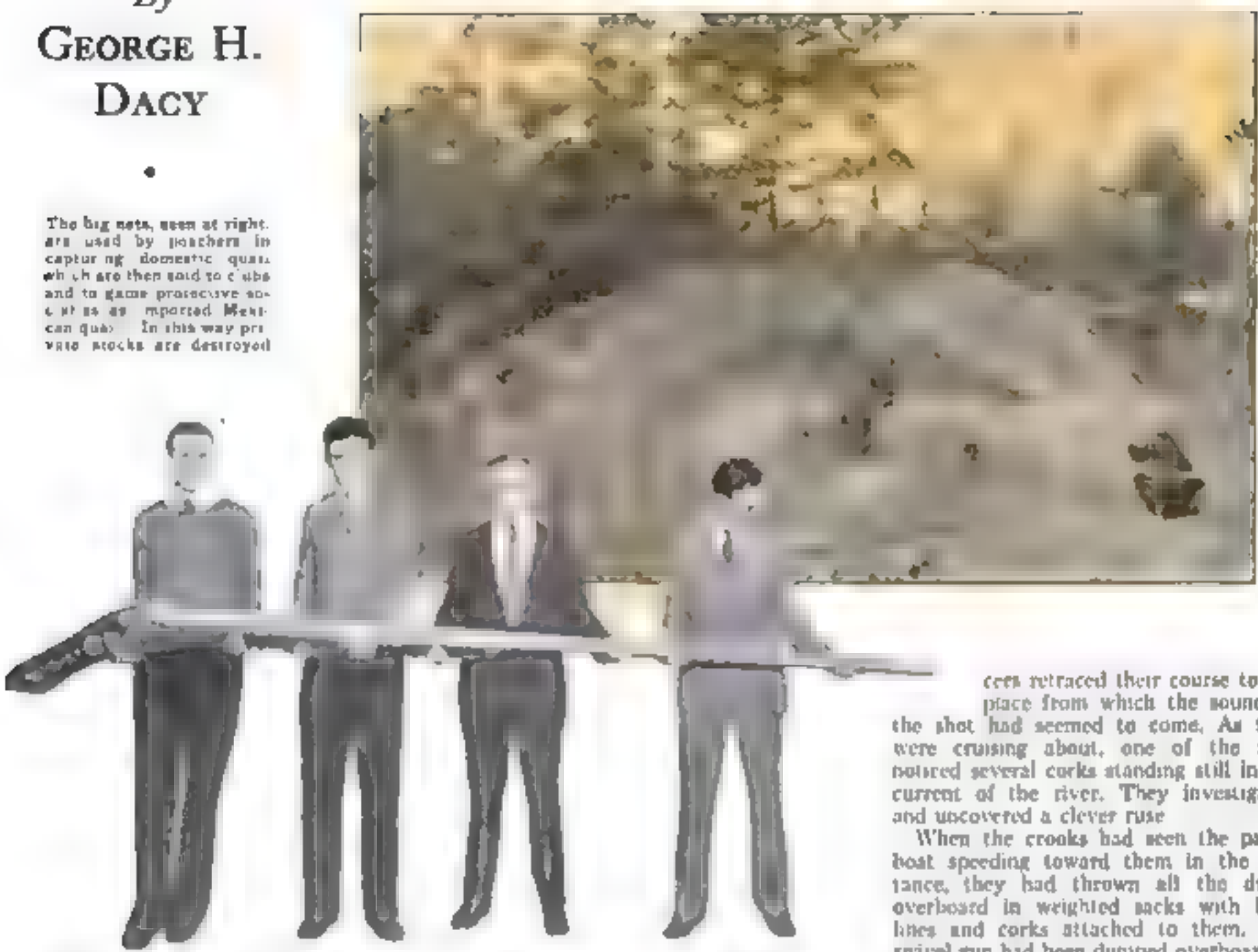
The big nets, seen at right, are used by poachers in capturing domestic quail which are then sold to clubs and to game protective societies as imported Mexican quail. In this way private stocks are destroyed



With this swivel gun, twelve feet in length, the poachers slaughter entire flocks of ducks, killing as many as 125 birds at a single blast. The gun is mounted in a boat bow on a recoil block

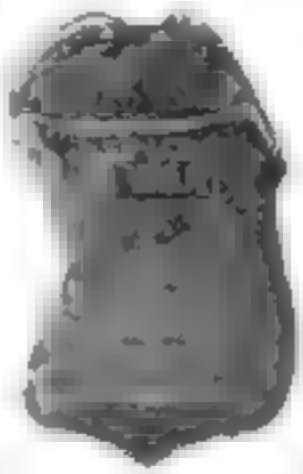
Time and again, the government agents have traced ducks to the refrigerators of such dealers. But, in every case, they have failed to obtain a conviction. In court, witnesses would testify that the game birds had been shot by sportsmen during the open season and had been left to "age" under refrigeration at the dealers where the birds were found.

In bagging the birds, the duck bootleggers use blinds, sink-boxes, motor boats, and even airplanes. Five-shot pumpguns are most commonly employed although some of the poachers use automatics with special extensions attached to the magazines to increase their capacity to nine shots to a single loading of the murderous gun.

During the last few years, government officers have confiscated a veritable arsenal of firearms from men engaged in illegal hunting. They range from single-barreled rifles to enormous punt or swivel guns, twelve feet long and requiring several men to handle.

These heavy artillery pieces are found most frequently along the Atlantic coast from Long Island to the Chesapeake Bay and the Back Bay of Virginia. They weigh several hundred pounds, have from one to fifty barrels and shoot a pound of powder and two pounds of shot at each pull of the trigger. Anywhere from fifty to 125 ducks are slaughtered by a single blast from these gigantic scatter guns.

Usually they are used at twilight when flocks of ducks are feeding on the water. The gun is mounted on a recoil block at the bow of a motor boat so it can be swiveled from side to side. Floating down upon a flock of birds, the poachers get into position and fire. Then, as rapidly as possible, they retrieve the dead ducks and speed away. Half an hour later, they repeat the performance miles away and with similar results.



This bullet-dented badge was worn by a game warden when poachers shot him

What happens when a government patrol boat hears the roar of the big gun and races to the spot, was illustrated recently almost on the doorstep of the nation's capital. Down the Potomac not far from Washington, a gang of duck poachers was operating a swivel "cannon" with deadly effect. When a government boat overtook the craft of the outlaw hunters, they found no gun, no ducks, nothing suspicious. The law requires that both the gun and the illegally killed game must be captured before the arrest is made.

Temporarily baffled, the officers retraced their course to the place from which the sound of the shot had seemed to come. As they were cruising about, one of the men noticed several corks standing still in the current of the river. They investigated and uncovered a clever ruse.

When the crooks had seen the patrol boat speeding toward them in the distance, they had thrown all the ducks overboard in weighted sacks with light lines and corks attached to them. The swivel gun had been dumped overboard in similar fashion. Later, when the government boat had left the vicinity, they planned to return, locate the game and the gun by means of the cork bobbers and retrieve both under the cover of darkness.

Duck bootlegging is but one of several types of poaching with which government agents must battle.

Along the Canadian border, for instance, illegal beaver trapping is a constant source of trouble. These animals are now nearing extinction and in states where they are found are protected by law. But the fur poachers, laying their traps at night and disposing of their catch by stealth, have been reaping a rich harvest of contraband pelts.

One loophole in the American law aids such gangs. The beavers, in felling trees and damming streams, sometimes do considerable damage. Consequently, most of the states with beaver laws have also passed legislation which allows their state game commissions to issue permits for trapping the animals where they are causing damage. On such permits, obtained under false testimony, fur bootleggers and their agents are trapping large numbers of the animals during closed seasons.

A gang of four men in Michigan was recently caught after it had carried on extensive operations in trapping beavers, mink, and otter out of season. For one shipment of furs, the leader cashed a check for $10,000. The country banker who received the check became suspicious. He (Continued on page 50)

Tests with ultra-violet light show that only a small quantity is suitable for forcing plant growth. Right, Victoria regia, tropical lily, grown in Ohio under artificial light bulbs

Latest Tests with Night Lights *Yield*

By WALTER

ELECTRIC light recently solved the problem of growing shrubbery and flowering plants around a model house inside a skyscraper.

In the Builders' Exchange Building, Cleveland, there is a full-size house that extends upward through three floors. It is maintained as a model for demonstrating residence-building ideas.

To make the model home complete, various plants were set around it, their roots embedded in earth. However, these plants refused to live for more than a few weeks. Investigation revealed that they were suffering from lack of moisture, which was remedied by the use of peat moss placed so that it prevented rapid evaporation. Still the plants refused to flourish.

Experts were called in from the General Electric Lighting Laboratories in Nela Park. They diagnosed the trouble as insufficient illumination and installed a battery of floodlights which produced four times as much illumination as the plants had been receiving. These were burned during the daytime.

Results were almost magical. Within six weeks the forsythia, flowering almond, azalea, and flowering crab were in full bloom. Larch, mountain ash, and bridal wreath came out a short time later, and euonymus, arbor vitae, privet, and Austrian pine grew steadily.

This is but one instance of a brand new scheme for forcing plant growth with artificial light. It is true that a few commercial applications of light forcing have been made, but most of the work done so far has been of an experimental nature. Results indicate that many of our most useful plants can be made to produce fruit or blossoms earlier and better, by putting them on an improved light diet. The process is so simple that almost anyone can employ it.

Water plants, used widely in home aquariums and garden pools, respond quickly to light treatments. In studying the action of such plants recently, investigators made a discovery that may prove a milestone in the plant-lighting business.

Frank B. Lee, General Electric lighting specialist, and Dr. J. T. Charleson of the William Tricker Water Gardens, set up three tanks. In them they placed identical collections of flowering arrowheads, tropical water lilies of a type particularly difficult to grow (General Pershing and Blue Beauty), shell flowers, and other aquatic plants. Each tank was planted and fertilized the same as the others.

Above the first tank, a 300-watt mazda lamp, of the type used for general illumination, was suspended, the distance from the water to the bulb being about thirty-six inches. Above the second tank was placed a 300-watt incandescent lamp having a special bulb which transmits the ultra-violet light generated by a tungsten filament. No lamp was placed above the third tank. Daylight reached all tanks in equal amounts.

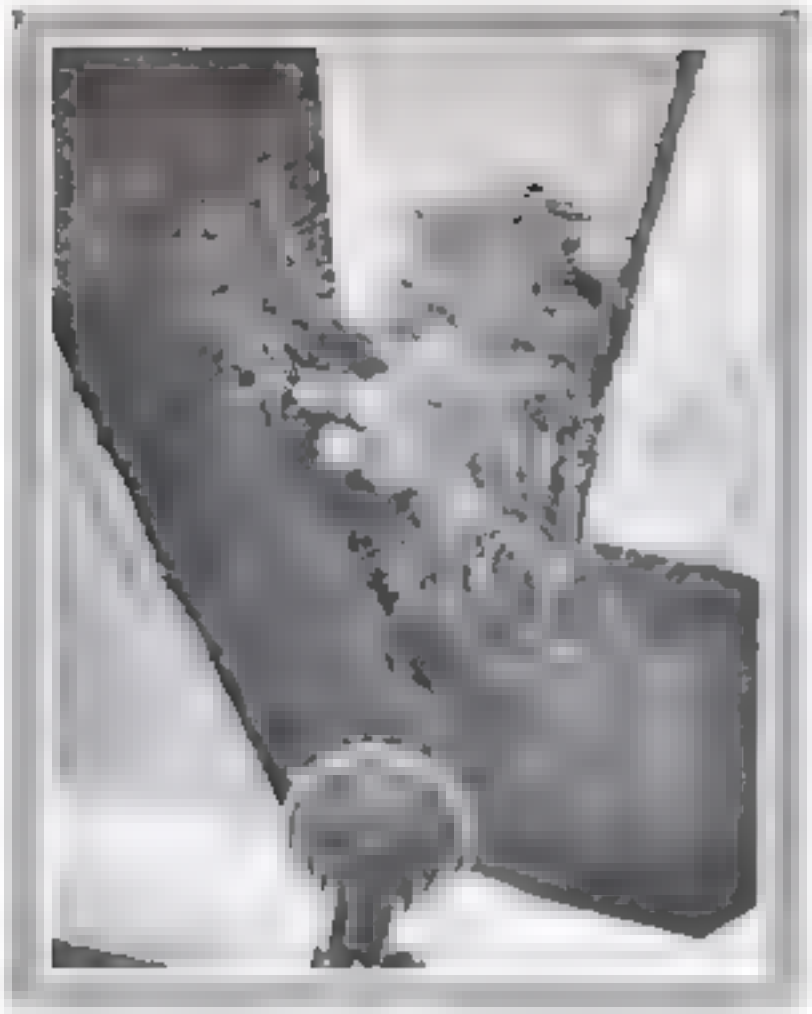
The lamps were burned five hours each night. During the experimental period the tanks received between nine and ten hours of daylight.

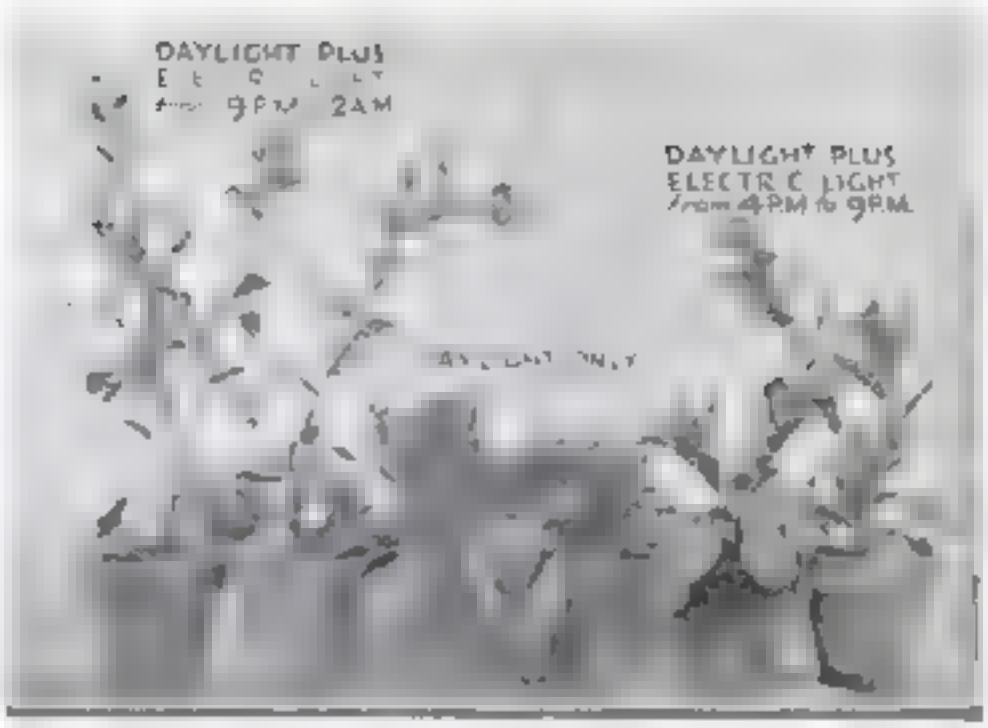
In the first tank, the plants flourished, but their leaves became ragged, partly caused by insects. In the third, the plants struggled along with little growth, and in some cases died.

In the second tank, the one having the ultra-violet-producing lamp, the leaves grew almost as well as if they were in summer sunlight, and the lilies produced well-developed flowers. Insect damage was negligible.

Light increases the amount of sugar in the sap of a plant. This is demonstrated by covering part of a leaf that has been taken from darkness into the brilliant sunlight

Generally it has been found that ultra-violet light is not beneficial to plant growth, and whenever the wave length exceeds the limits of ultra-violet light emitted by the sun, harmful results, such as burning of the plant tissues, are produced. The tank experiments indicate that near ultra-violet, such as that emitted by the



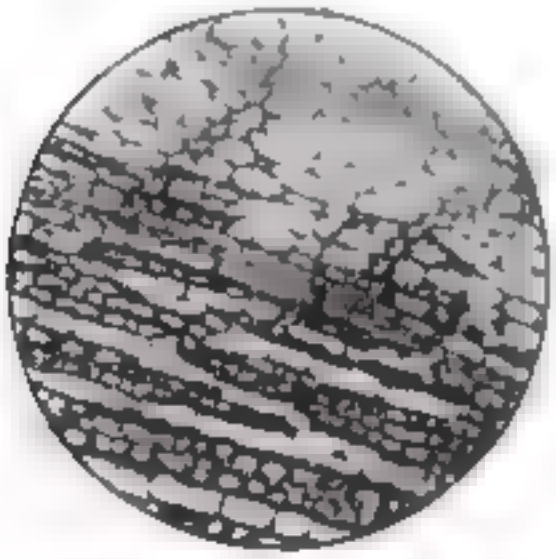


HOW PLANT GROWTH VARIES WITH LIGHT
All the calendulas above received sunlight but in addition those at left were under electric light from 9 P M to 2 A M and those at right from 4 P M to 9 P M The test was made at Purdue Agricultural Experiment Station

These shrubs were successfully grown indoors by the use of artificial light They surround a model house in a Cleveland skylight

New Marvels *in* Plants

E. BURTON



Photomicrograph of leaf cells in a water plant showing the chlorophyll or coloring matter through which sunlight acts

lamps, may be used to force blooming of water plants and perhaps others. Two theories concerning this action will be investigated. One of them assumes that the ultra-violet acted in some way on the plant itself to induce blooming The other theory is that the light caused certain fertilizing agents in the water to be formed or to become more active

Experiments with a lamp installation in a Cleveland greenhouse resulted in the production of leaf lettuce of a usable size two to three weeks ahead of schedule Three beds were planted. No artificial lighting was maintained at one. Above the second, ordinary 150-watt lamps were suspended, five feet above the soil and on eight foot centers. Above the third bed ordinary 300-watt mazda lamps were placed, their spacing and distance above the beds being the same as the others The lamps were burned four hours each night, preceding dawn. Temperature was kept constant

The unlighted control bed produced lettuce to a height of seven inches during the experimental period. Average height of plants in the 150-watt bed, where the illumination was fifteen foot-candles, was nine inches. The 300-watt bed, with an illumination of thirty-four foot-candles produced eleven-inch plants

All of the plants were cut at the same time and weighed. It was found that the weight gain was not in the same proportions as the advance in size. The 300-watt lettuce gained about thirteen per cent in weight over that in the unlighted bed, while the 150-watt plants showed half as great increase. This indicates that, perhaps within certain limits, forcing is in proportion to the amount of light

Dr John M. Arthur, of the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., points out that only the visible and near ultra-violet regions of the spectrum are useful to plants in the process of photosynthesis—the conversion of light energy into starch wood, and cellulose and that both the red and blue regions are necessary Plants grown only in red light are tall, with thin stems and slender leaves, and resemble plants illuminated with white light of very low intensity. On the other hand, when all but blue light is screened out, the plants are short and squatty, with thick stems and leaves. Apparently the two extreme regions of the visible light spectrum are necessary to balance each other, as far as plant growth is concerned

Experiments have shown that, to force plants into producing greater weight in a short period of time, relatively high light energy is required, but to regulate flowering, relatively low light intensities, as low as ten foot-candles, are sufficient.

There are long-day plants and short-day plants. The first group includes those that blossom normally only during the long summer days, when they receive many hours of day light. Examples include the radish, lettuce, portulacca, and water lilies. Among the fall-blooming plants which are brought to flower by shortening the length of daylight periods, are salvia, dahlias, cosmos, ragweed, and chrysanthemum

If, during the winter, daylight hours are extended by means of electric lamps flowers can be produced months ahead of time on plants that blossom normally only during the long-day summer period. On the other hand, flowers can be delayed on chrysanthemum and other short-day plants by employing similar light treatments.

This is the essence of the new science of plant control by means of artificial light. But it is not quite the entire story Many plants respond to treatment which consists of reducing the daylight hours instead of increasing them. Usually light-tight covers or boxes are used. Commercial installations demand something that is not costly

Alex Laurie Professor of Floriculture at Ohio State University and G H Poesch during several years of experimental work *Continued on page 102*

STREAMLINED SHIPS GET WIND TEST

In this wind tunnel, self-moving streamlined ships are tested to find the design that is best calculated to decrease the wind resistance

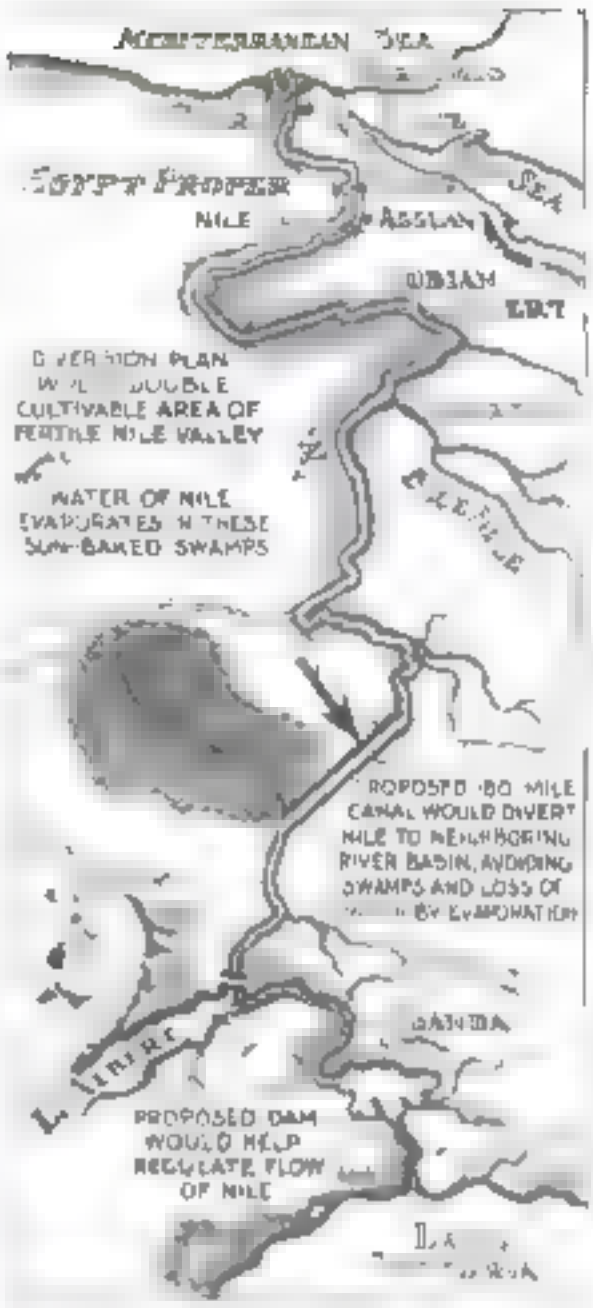
A stream of smoke chemically generated in the apparatus in the foreground below is blown from the funnel of the model ship to be sure smoke will not trail across deck

Now that better hull designs, by decreasing their under-water resistance, have made ocean liners faster, marine engineers in a Berlin, Germany, laboratory are seeking to boost the speed of ocean travel a little more by improved streamlining above the water line. Models of a liner's superstructure are exposed to an air blast at the mouth of a wind tunnel to reveal the best design for minimizing wind resistance. The course of air passing over the models is shown by silk threads at the end of a rod in the experimenter's hands. Artificial smoke is also released from the funnels of the model showing whether the design will cause objectionable fumes to trail across the upper decks to the annoyance of the passengers

PROCESS WATERPROOFS ANY CLOTH

Treated by a new process, a sheer silk stocking will hold water as shown. At right, waterproofed hat, dress and coat

Drenched by an unexpected shower, the wearer of apparel treated by a new chemical waterproofing process remains bone dry. The remarkable process, perfected by a New York dress manufacturer after a year and a half of research, may be applied to cotton, linen, wool, and even costly velvets and silks without altering their appearance or feel. When a sheer silk stocking thus treated, is slipped over the palm of the hand, water placed upon it rolls about like a globule of quicksilver without wetting the fabric. According to the inventor, his process may be applied to suits and dresses, hats, shoes, pocketbooks, window curtains, policemen's uniforms, and airplane wings.



BIG CANAL TO CHANGE COURSE OF RIVER NILE

Plans to turn the River Nile from its course and send it through a 400-mile detour, a mighty engineering feat ranking in magnitude with the building of the Pyramids, have just been announced by the Egyptian government. The unusual object of the diversion plan is to save the river's precious waters from evaporation by the sun before they reach the fields that need them. The plan is expected to double the productiveness of one of the most fertile agricultural regions in the world.

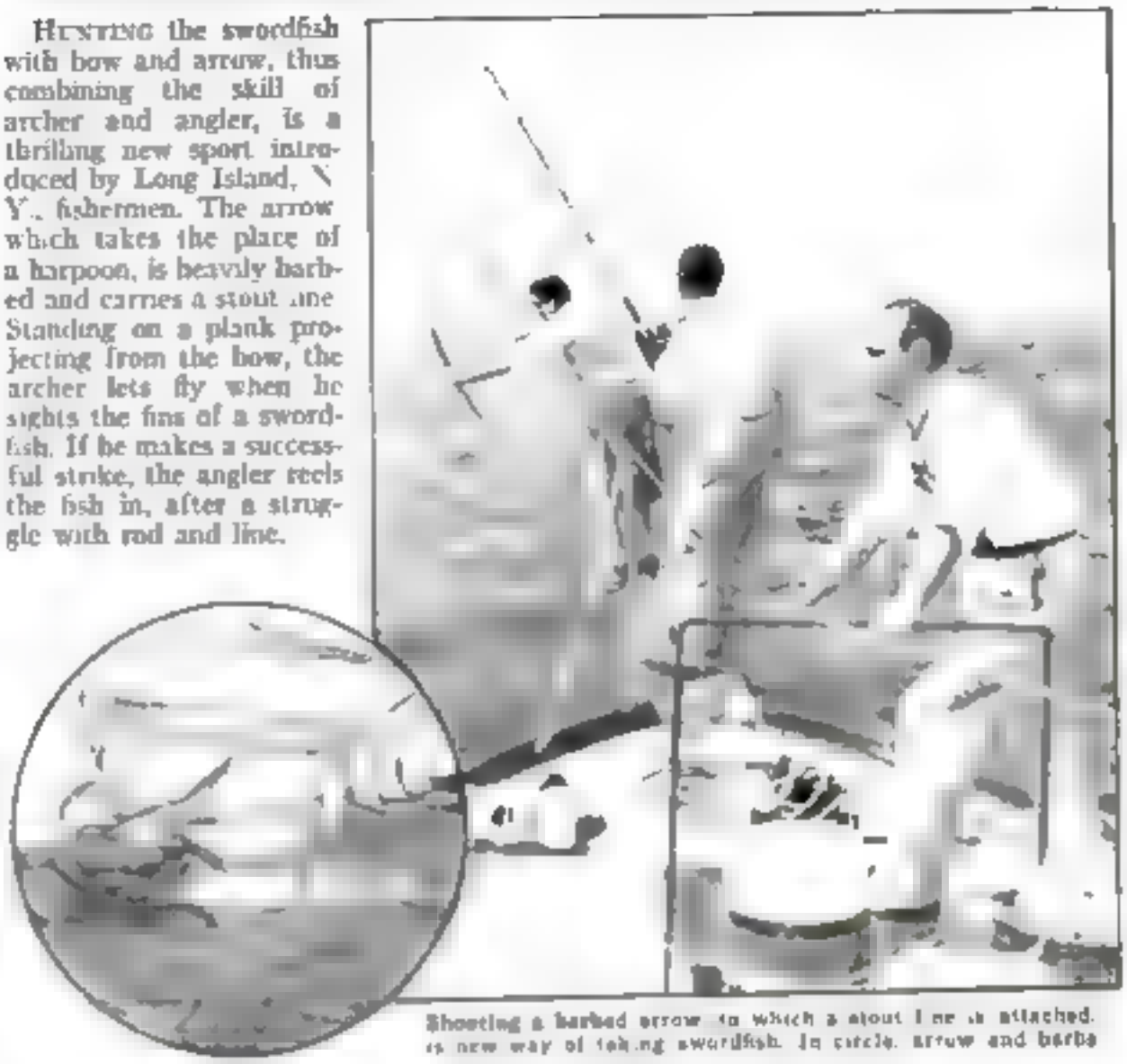
For a length of several hundred miles of flat country in the upper part of its course the flow of the Nile is sluggish and its channel has no banks. Here its waters form vast swamps, and the burning rays of the sun rob the river by evaporation of much of its flow. Hence it is now proposed to cut a 180-mile canal from a point above the swamps to another river that rejoins the Nile below them, thus detouring the Nile around the place where it loses its water, as shown on the map above. Narrow and deep, the canal would expose little of the water to the sun's rays. Engineers who have penetrated tropic jungles, to survey the route, report that use could be made of parts of existing river basins along the way. Even so, the project, including a flood control dam above the canal to protect it from damage, is expected to require at least twenty-five years for completion. An alternative proposal, to cut a deep, walled-off channel through the swamps, has been under consideration, but the canal plan is considered more feasible

THERMOMETER GAGES SOLDER'S TEMPERATURE

To aid in the proper application of solder, whose ingredients, lead and tin will not remain intimately mixed if the temperature is too hot or too cold, the new solder thermometer, illustrated above, has been devised. The bottom of the all-metal instrument is plunged into molten solder, the fluid entering holes. The temperature is read from a pointer at the top, on a numbered scale. When the pointer reaches three, the solder is ready

KILL SWORDFISH WITH BOW AND ARROW

Hunting the swordfish with bow and arrow, thus combining the skill of archer and angler, is a thrilling new sport introduced by Long Island, N. Y., fishermen. The arrow which takes the place of a harpoon, is heavily barbed and carries a stout line. Standing on a plank projecting from the bow, the archer lets fly when he sights the fins of a swordfish. If he makes a successful strike, the angler reels the fish in, after a struggle with rod and line.



Shooting a barbed arrow to which a stout line is attached, is new way of taking swordfish. In circle, arrow and barbs

SHELVES MOVE IN NEW STORE

Comfortably seated in a self-service grocery store just opened in Los Angeles, Calif., a housewife selects her purchases from moving shelves of price-tagged merchandise that pass before her. The endless, motor-driven chain of shelves, makes a complete circuit in eight minutes—leisurely enough for the customer to make her choices and lift the articles from their shelves. When her basket is full, she pays the cashier

From the moving shelves of the self-service grocery store shown above the purchaser selects goods as they pass on endless chain

ONE TOOL CUTS, REAMS AND FLARES TUBING

Tubing is quickly cut, reamed, or flared with a new combination tool for the home mechanic. For cutting, the tool is clamped over the tubing and revolved around it as shown below, while the screw handle is gradually tightened, forcing a cutting wheel through the metal. A pointed reamer at the tool's end will then remove any burrs. If the tube is to be connected with a coupling, a flare is put on the end by forcing the conical end of the handle into the tube.

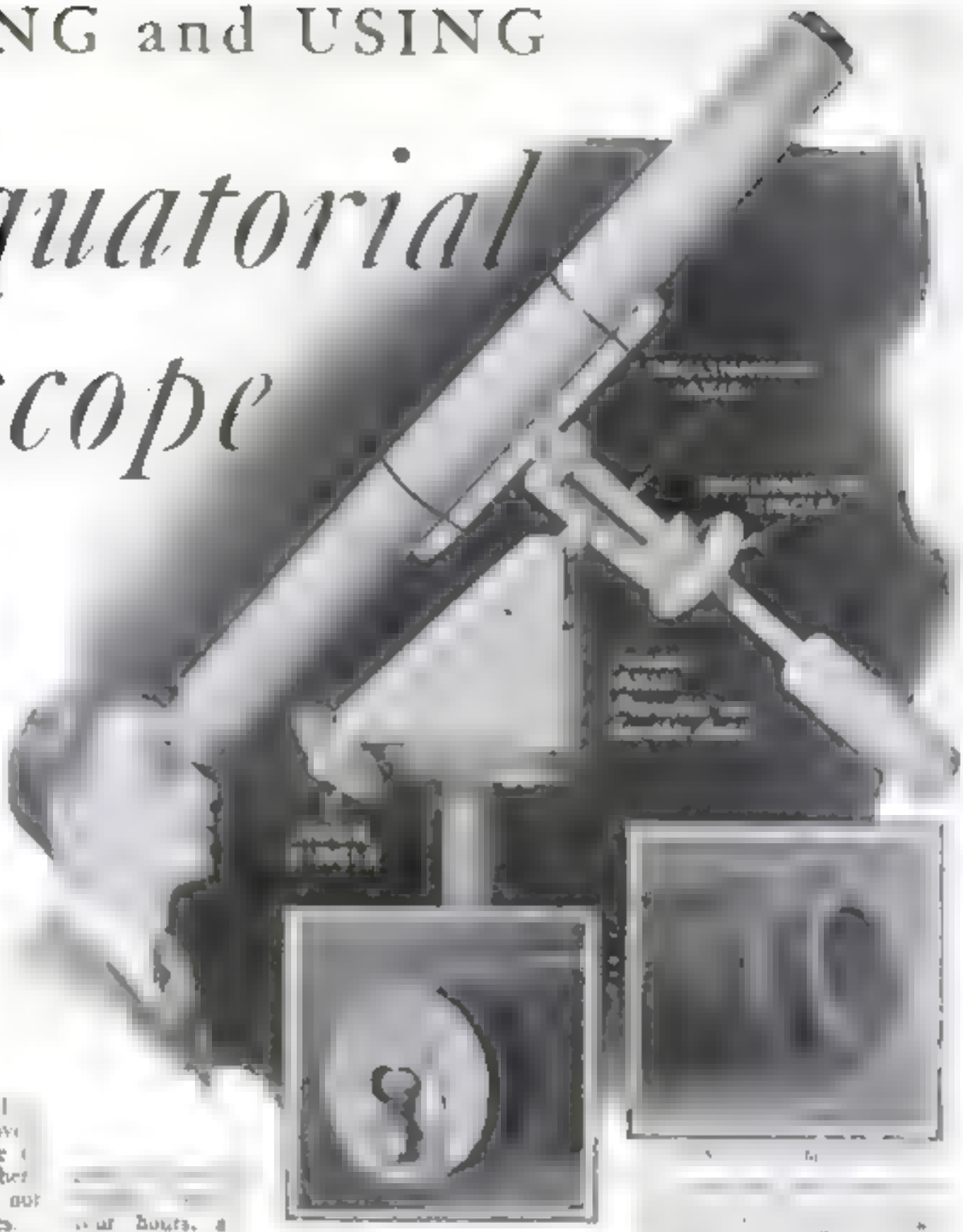
With this handy tool, tubing can be quickly cut, reamed, and then shaped as is desired

USE AIRPLANE TO FIND DINOSAUR FOSSILS

Hunting dinosaurs by airplanes is the newest method of fossil collecting adopted by Barnum Brown, of the American Museum of Natural History. From the air, he says, the beds of yellow sandstone where the bones are likely to be found are plainly visible.

MAKING and USING

An Equatorial Telescope



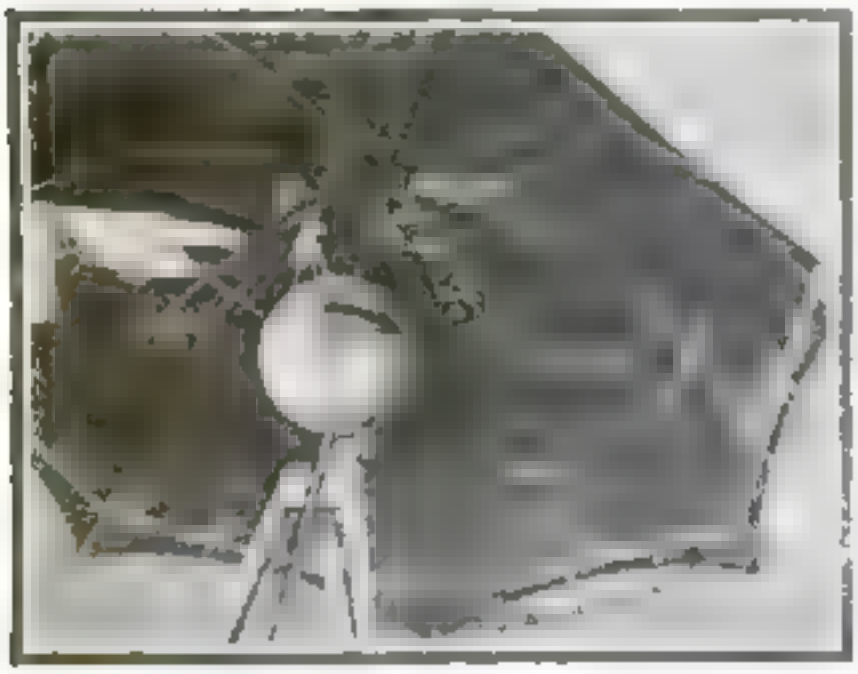
AFTER [illegible] the [illegible] last month, it will be easy now for you to build an astronomical telescope with an equatorial mounting. Let us consider the mounting first, for you may already have a telescope of some kind or you may prefer to buy one rather than make the simple one I am about to describe. The mounting is necessary in either case.

This equatorial mounting is used in all professional observatories as it enables the telescope to follow any star steadily by turning upon an axis parallel to the polar axis of the earth. As you already know the earth's axis points approximately to the North Star, so the axis of our equatorial mounting must do the same. In the latitude of New York, as you have proved, the polestar is elevated at an angle of about forty degrees above the northern horizon. Accordingly, the slant of our telescope's polar axis is forty degrees.

Look at the three pictures showing the miniature model of an equatorial telescope attached to a globe and you will see how the slow turning of the telescope from east to west on its polar axis enables an observer to keep any star in view for twenty-four hours.

Since the complete rotation of the [illegible] hours, astronomers decided to locate the east and west positions of stars by great imaginary circles drawn, at hourly intervals, through the poles of the sky at right angles to its equator. In our pictures some of these meridian lines (called "hour-circles") are represented by the ribs of the umbrella

[illegible] angles to each other. The polar axis [illegible] parallel to the earth's axis and the declination axis [illegible] at right angles. In following a star's motion the telescope turns on the polar axis. Inset above: telescope's object glass made from camera's portrait attachment. Left: eyepiece made from pocket lens magnifier with short focus



HOW ASTRONOMERS LOCATE THE STARS

Astronomers use a line passing through the polestar and Beta Cassiopeiae as the zero-hour line of the skies. Twenty-four one-hour divisions are measured from this line on the sky's equator from west to east. The hour line passing through a star is called its right ascension. Its declination is its distance in degrees north or south of the equator. The right ascension of Beta and Capella is zero and five hours respectively. Beta's declination is 60 degrees. "A" is polar axis of earth. "B" polar axis of the telescope mounting

It was also decided that the starting line should be the circle passing through the polestar and one of the stars in the "W"-shaped group called Cassiopeia. Another illustration shows how the hour circles are marked off on the equator all the way round the sky, from zero hours to twenty-three hours. Twenty-four hours is of course identical with zero hours.

To see how an equatorial mounting works, let us imagine that an astronomer points his equatorial telescope at the star Beta Cassiopeiae, which is exactly on the zero hours circle, and starts the clockwork which turns the telescope westward on its polar axis while the earth turns eastward. All night the clockwork will keep Beta Cassiopeiae in the telescope's field of view. When the sun rises, the instrument will still be pointed at the star's position, and when darkness comes again, Beta Cassiopeiae will still be in the tele-

Homemade Instrument, Magnifying 100 Times, Is Easily Put Together of Odds and Ends Found in Any Home

By Gaylord Johnson

HOW TO FIND STAR'S POSITION The model telescope in the pictures above is used to show how you can find the position of a star even in bright daylight. On a September evening turn the telescope down until the declination pointer falls across the figure 38. This is Vega's declination. Then adjust the hour circle on its polar axis until the pointer indicates 18½, which is Vega's right ascension. Now turn the hour circle pointer to 19¼, which is Altair's right ascension. When the pointer is turned to eight degrees, it will indicate Altair

scope's field of view. The instrument will still be pointed at the zero hours line after following it completely around the sky for twenty-four hours.

I have chosen a circumpolar star which never sets in the latitude of New York but the same thing would hold true of any other star. The following evening the telescope would be pointed at the same spot in the heavens, after turning completely round upon the polar axis of its equatorial mounting.

Of course, only very expensive telescopes are provided with clockwork to drive them, but the equatorial mounting is just as great a convenience to the amateur stargazer for it enables him to follow a heavenly body very easily with his telescope.

Also, after the hour-circle dial on the polar axis is set so that the pointer indicates zero hours on the dial (while the telescope is pointed at Beta Cassiopeiae) the telescope can then be pointed to the hour circle of any other star in the sky by turning the pointer to the correct figure on the hour-circle dial of the mounting. After this, the star can be brought into view by turning the telescope north or south upon its "declination axis" until the "declination pointer" indicates the star's proper declination.

Declination on the sky is equivalent to latitude on the earth which is why the declination of the polestar or sun enables us to compute our latitude.

The east and west distance of a star from the zero hours circle (called its "right ascension") is also similar to longitude on the earth. The difference is that longitude is measured in hours east or west of the earth's meridian which passes through Greenwich, England, while right ascension is measured continuously eastward from zero hours completely around to zero hours again. This measurement eastward is called "right ascension" because, when you face the northern horizon, the stars always ascend above the eastern horizon on your right hand.

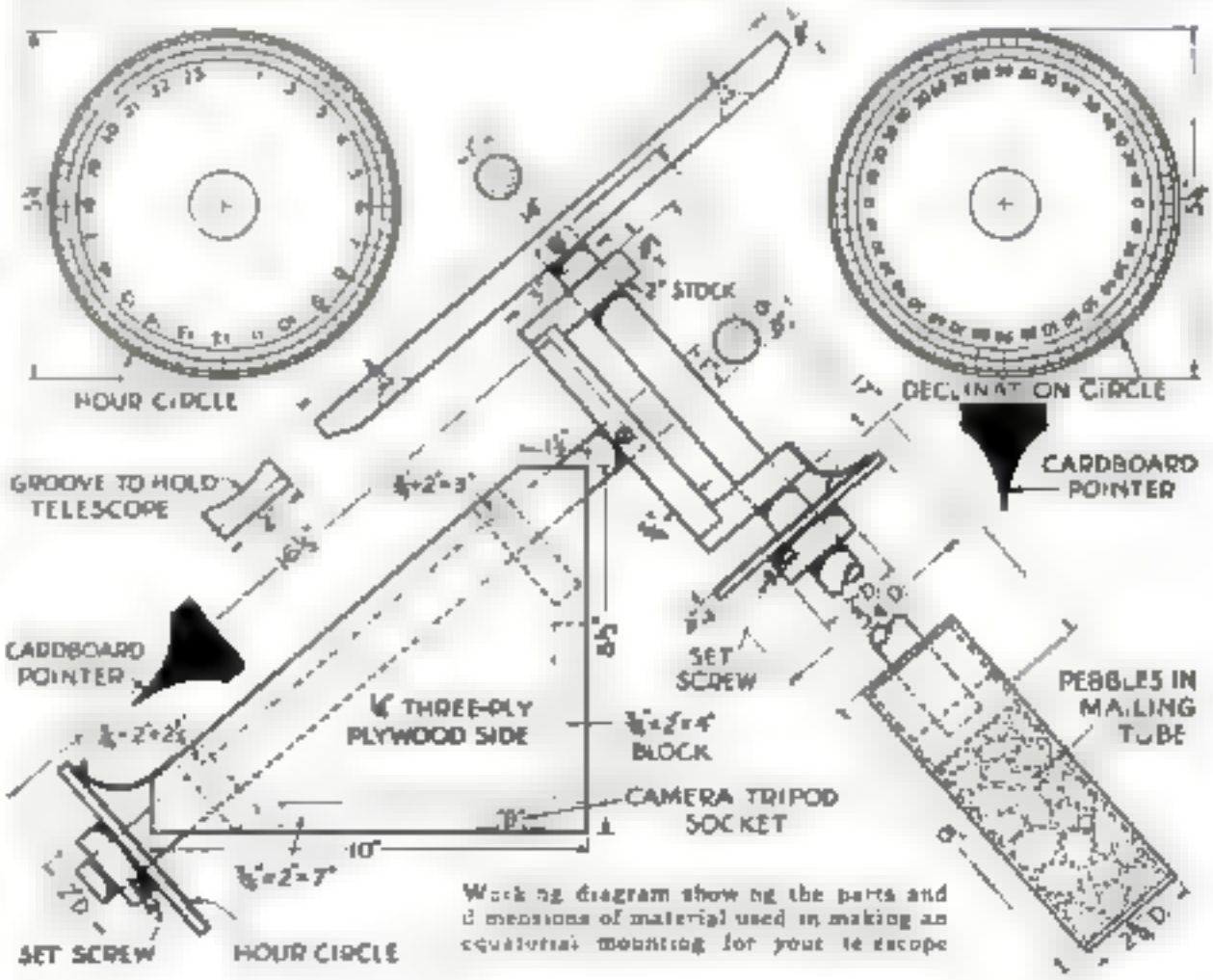
Declination and right ascension (often abbreviated to R. A.) can be illustrated simply in the following way:

Stand outdoors at night and turn your eyes upward toward the sky's equator, with your back to the polestar. Then turn your head from east to west. Your head is then working as an equatorial mounting for the binocular telescope of your eyes. As you turn your head from east to west it is turning upon the polar axis in your neck. And as you nod your head up and down, sweeping your eye-telescopes from zenith to horizon, your head is turning upon its declination axis.

With the scale plan shown and the pictures of the mounting in the illustrations you can easily construct a practical equatorial mounting that will give good service with a light telescope. Note that the hour-circle pointer points to the meridian of the equator, and is fastened to the lower bearing of the polar axis. The declination pointer indicates the north pole of the heavens and is fastened to the bearing of the declination axis.

The telescope illustrated in the photographs was made with a portrait attachment lens for the object glass, and a folding pocket lens for an eyepiece. The portrait attachment lens has a focal length of thirty-six inches. The pocket lens has a focus of about six-tenths of an inch. By using a simple rule, we can now find the magnifying power of the telescope. The rule is, Divide the focal length of the object glass by the focal length of the eyepiece. The result will be the power of the complete instrument. My telescope therefore is of sixty power. It apparently brings the moon many times closer and plainly shows me its craters.

If you wish to make a telescope giving you 120 magnifying power, secure from an optician a weak positive spectacle lens of six feet focal length to use for your object glass. Then make your telescope barrel long. (Continued on page 91)



Working diagram showing the parts and dimensions of material used in making an equatorial mounting for your telescope

By James Montagnes

For many years Canada's police force has gone into the wildest regions of the country on horseback up the trail of crooks. Now with better roads they are going farther and faster on motorcycles or in speedboats, cars or even faster planes

MECHANIZING *the Famous* Mounties

ROYAL Canadian Mounted Police are now riding motorcycles, 250 of these machines having been sold recently to the famous force. The last report, also shows nearly 200 motor cars in use. The operation and care of gasoline engines is now part of the course of training taken by every recruit joining the Royal Mounted. Mariners and radio operators are today included in the membership of the force

Fast transportation and faster communication are speeding up the work of the Mounties throughout the Dominion. The force can still claim the distinction of being mounted, but now the horses are being replaced by mechanical mounts. In ten years the number of horses in the force has dropped from 655 for a membership of 1,227 to 263 for a membership of 2,548

Why this change? Why is the horse being forced into the background?

Crime moves fast today and guardians of the law must not lag behind To catch the present swift-traveling criminal, the horse is too slow. So police now use not only motor cycles and fast automobiles, but also speedboats, cruisers, outboard motors for canoes, skiffs, and other small craft, airplanes, and, naturally, the radio

New duties constitute another reason for the mechanization of the Mounted Police. The force now patrols the border waterways to catch smugglers of contraband and aliens. The customs preventive service was recently taken over by the police. Today Mounted Police keep tab on speeders in federal parks and on the provincial highways of Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, and Prince Edward Island. To check up the traders, trappers, prospectors, and natives in the vast northern region, motor launches give quicker transportation in summer than the canoe.

NOT long ago a constable on winter patrol in the Coronation Gulf district of the Arctic coast heard of a native murder Within a few days, he had found the murderer Within a few weeks, he had taken the prisoner to the post at Cambridge Bay and had used the radio station on a schooner frozen in there to give his report to Ottawa. Three days from his arrival at the post with his prisoner full instructions had been given the constable as to the disposal of the case. More than 2,200 miles of unsettled territory had been covered by radio, many months of weary travel had been eliminated by the use of fast communication. Compare this with the fact that in same region in 1917 five years of travelling back and forth between the Arctic and civilization were necessary in the capture and trial of another murderer

A CONSTABLE in a motor car on patrol duty along the New Brunswick coast saw a schooner off shore, which he took for a smuggler That night the police patrol boat started out With only two short flashes of light from the schooner to guide them, the police seized a motorboat laden with contraband. Leaving a constable in charge of the seized motor boat, the police patrol boat started out after a second motorboat which had a muffler and exhaust under water and could only be followed by listening. So well have the police adapted themselves to their new duties that before the operator of the silent boat knew what had happened the police craft bumped into him, a constable jumped aboard, ordered the boat stopped and found a second load of contraband concealed under fishing nets.

At a northern Ontario trading post, a

Canada's Police Now Use Motor Bikes, Cars, and Airplanes to Get Their Man

•

big Indian was causing a lot of trouble. He was thought to be slightly insane. Over forestry services a radio a message was sent to Ottawa. Two days later a plane brought a mounted policeman to the post, and the Indian was flown to a mental hospital.

Along the Arctic coast, the police still carry the mail in winter time. Once this meant untold hardship in fighting Arctic storms. It took many weeks before the east and west bound mail was exchanged between Akiavik and Bernard Harbour. Now the two men leave with their mail after making arrangements by radio, cutting down on the time on the trail.

THE last annual report of the force shows that four men of the western Arctic division had gained their governmental short-wave radio licenses, which means they had demonstrated their ability to operate their stations by means of the dot and dash and could repair the equipment in case of breakdown.

One of those four men is the radio operator on the floating detachment of the force, another factor in the task of speeding up police activity. The *St. Roch* is a permanent post of the organization, and its motors carry it along the Arctic coast on the duties of the force which include licensing fur trappers, seeing that the natives are not exploited, keeping up to date information for the Vital Statistics Act, licensing radio receivers and collecting customs duty. A floating detachment was unthought of when the Mounties first hit the trail in 1874—on horseback.

Wearing this uniform of fur, the Mounties invade the Arctic on the trail of criminals.

The airplane has also come into wide use. The force does not yet have its own planes and pilots, but even that day is not distant. For the range of professions embraced by members of the force has grown from cobblers, tailors, and carpenters to include the mechanical and engineering vocations, electrical workers and able and experienced seamen.

The airplane played a prominent role in the western Arctic a few winters ago when Albert Johnson, a trapper, accused of lifting traps, defied the police and started a man hunt that lasted nearly two months. A plane, following his tracks, shortened the hunt and also carried supplies and men between Aklavik and the scene of action, and rushed those killed and wounded in the hunt to the northern metropolis.

Today inspectors and superintendents of the force no longer rely exclusively on dog teams and water transportation for their numerous inspection trips. There are too many posts, spread too far apart to allow this slow method of travel. Airplanes are used to a large extent.

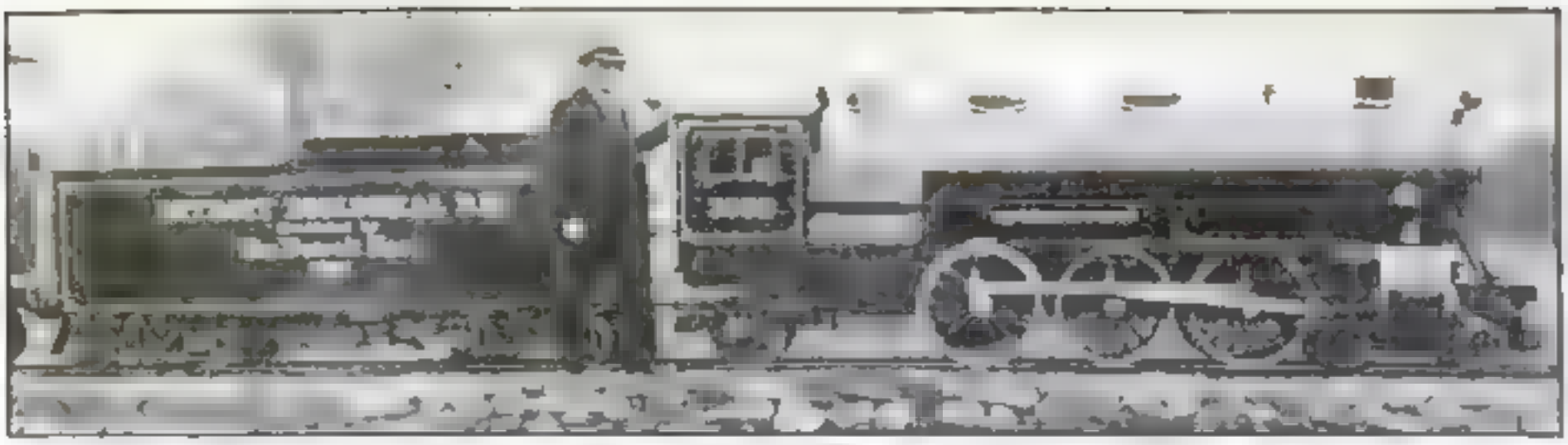
There is another angle to this use of airplanes and motorboats by officers as well as men. It saves time and lessens hardships. In addition it is cheaper. It costs money to feed the dogs and the men and food runs high in the northern parts of the region policed by the Mounties. An airplane cuts days to hours and weeks to days, [illegible] in operating the force results.

Flying Mounties keep an eye on the vessels along the coasts of the Atlantic and the Gulf of St. Lawrence. The patrols in that region have proven so effective they are to be enlarged. One officer in the Maritime provinces has asked for an even more mechanized force to cope with the smugglers. He would have motor cars and airplanes keep in close contact by use of radio.

The force now has 101 motor boats and the constables no longer paddle canoes. Outboard motors speed them to their destinations, leave them fresher for their duties, and terrorize crooks.

MOTOR boats are helping out where supply ships cannot go because of ice conditions. On several occasions posts that otherwise would have had to make a long haul overland for their annual supplies because of the inability of the steamer to make the isolated post, have had their supplies delivered by the police motor boat.

Even the caribou have been partly saved from faster extinction by motor boats. Some of the posts in the Hudson Bay area short of dog feed were contemplating hunting for the fast dwindling herds of caribou to feed their dogs. Word of their intention reached the post at Chesterfield. There ample supplies of dog feed and dog biscuits were on hand. A motor boat brought these to the short rationed posts. A few caribou were able to go on grazing. (Continued on page [illegible])



SMALLEST GAS-ELECTRIC ENGINE CARRIES VISITORS AT ZOO

Designed to run on a track thirty inches wide the smallest gas-electric locomotive ever built has just been delivered to a Detroit, Mich., zoo. It will haul seven cars of passengers over a miniature railroad a mile and a half long, from the main entrance of the zoological park to the exhibits. To save visitors a tiresome walk the railroad was installed two years ago by a Detroit newspaper, and equipped with gasoline locomotives. The new gas-electric model is illustrated above

ELECTRIC EYE PUT IN TINY BULB

Especially useful for [illegible] in close quarters [illegible] serve as an electric eye, a new photoelectric tube resembles an auto headlamp bulb both in size and appearance. Despite its smaller size, its performance is declared equal or superior to that of larger models. According to General Electric engineers who developed it the tube is unusually sensitive to infra-red rays and responds to the heat of [illegible] but is not over glowing visible

NEW MOTOR CYCLE SIDE CAR CHECKS RACING ACCIDENTS

In races for motor cycles with side cars, the passenger hitherto has occupied a perilous position, for he has had to depend upon the skill of the driver to avert an upset at a sharp turn in the course. To reduce the risk of a spill and make possible better records a racing side car has been devised by Alan W. Brace British holder of the world's side car motor cycle speed mark. When the machine whizzes toward a turn the occupant of the side car spins a steering wheel, thus banking or tilting the cockpit and aiding in rounding the bend

Old tin cans used at a Butte Mont. mine to recover the copper that is dissolved in waste water

TIN CANS RECOVER COPPER IN WATER

Few things seem more useless than old tin cans, yet they aid in producing much of the world's supply of copper. Waste water from a mine, containing dissolved copper salts, is pumped into great troughs containing thousands of the discarded receptacles. The cans dissolve and through a simple electrochemical reaction a sludge of pure copper is left in their place. Legend has it that a man in Butte Mont. discovered the process by accident when he tossed a few cans into mine water running through his backyard. Finding to his astonishment that they turned to copper, he acquired a year's rights to the water and became wealthy before his contract expired

Diving Suits Used to Raise Mastodon Bones

recover them. Divers
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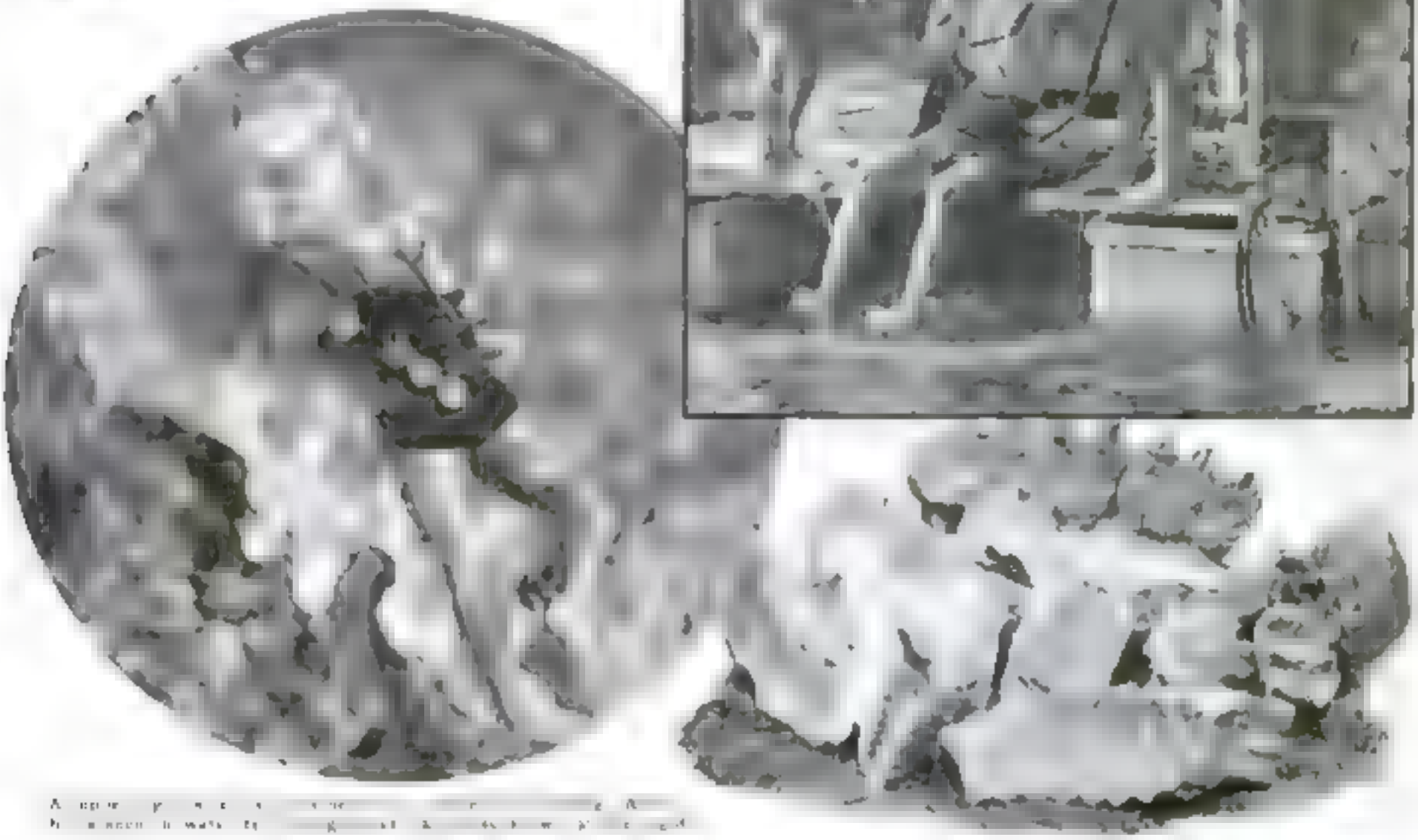


ELECTRIC "PIANO" SOUNDS LIKE 'CELLO

Resembling a miniature piano in appearance, a new musical instrument devised by a French inventor for radio broadcasting, yet is tones
like
the

stead of being produced by the mechanical vibration of strings, the musical sounds are created electrically by a bank of vacuum tubes resembling those used in radio. The tones
re made audible by a loudspeaker built into
op of the instru-
Unlike other
sical instruments
require bulky
fiers. The entire
ratus is compact

New electrical instrument for radio broadcasting, looks like a piano but its tones are like those of a 'cello. The instrument, as photo shows, is compact and also self-contained

TAKE X-RAY PICTURES ON PAPER INSTEAD OF FILM

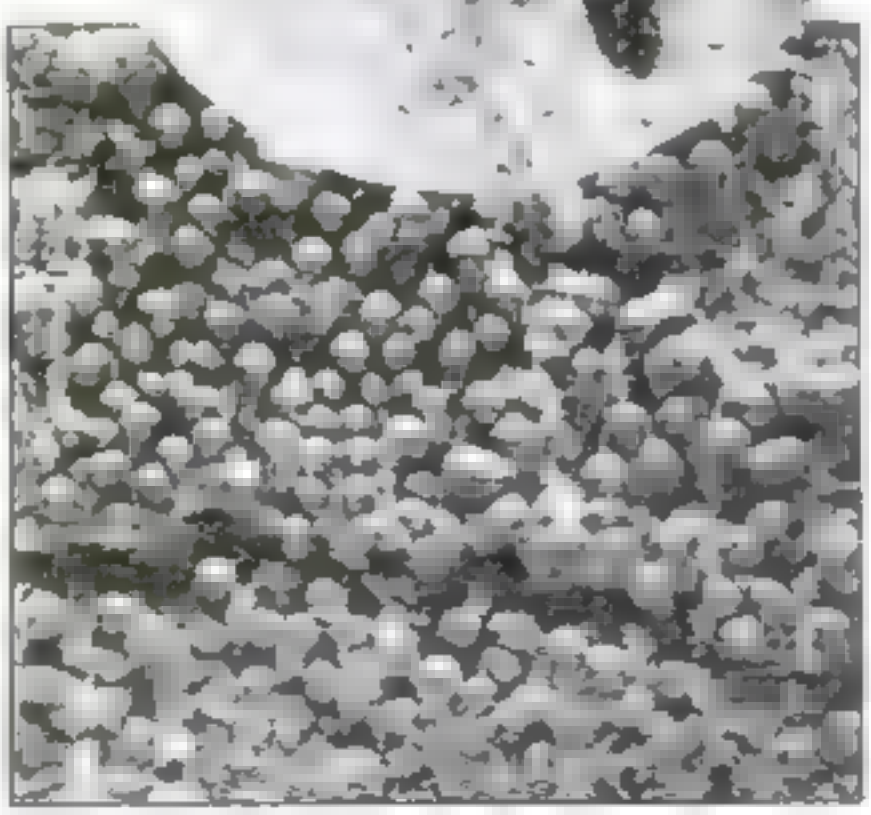
X-rays on paper instead of on film are made possible by a new process that is said to cut in half the cost of industrial X-ray inspection of welds and other objects. The paper is held in a special holder, illustrated above, and two sheets are exposed at once. One is kept on file, and the other submitted with the material tested. Easier to handle and drying more quickly than film, the paper is said to give as good or better results in industrial use and its general adoption is a possibility

Invisible Chemists *found*

By BORDEN HALL

This photomicrograph shows a large form of mycetozoa on the spore stage. It is from these spores that amoebas come to form masses of plasmodium that actually eat tiny bacteria

To see clearly the minute specimen of plasmodium a needle and scalpel are used to place a small piece in the center of a glass slide which is then put on microscope's stage



Photomicrographs by the Bausch & Lomb Optical Co.

ENLARGED SPORES OF THE SLIME MOLD

In circle, photomicrograph of slime mold magnified 120 times, and showing network of fine branched strands mixed with spores in the sporangia of many myxomycetes. At right, a photomicrograph of bark fungus enlarged one and a half times. The mushroom shape of spores is visible

AMONG the most fascinating and perhaps among the most useful forms of microscopic life known to man are the mycetozoa, moldlike organisms found in the deep woods. Their swift life cycle presents a multitude of forms and a perfect riot of color. At certain stages these tiny creatures make surprising balloon journeys through the air. It is a form of life so varied, so alive, and so baffling that we could spend years and years investigating it without, probably, adding anything new to the vast number of facts already known about it.

If you live in the country or on the outskirts of a city, it is likely that you will be able to find millions of mycetozoa in your back yard. After you have found them, you will have trouble deciding whether your captives are plants or animals for the mycetozoa pass through a life cycle that is extremely confusing both to the zoologist and the botanist. Today many authorities consider these mites as animal but admit that, in their system of propagation, they are vegetable. As a result, the statement that they are animals is not universally accepted.

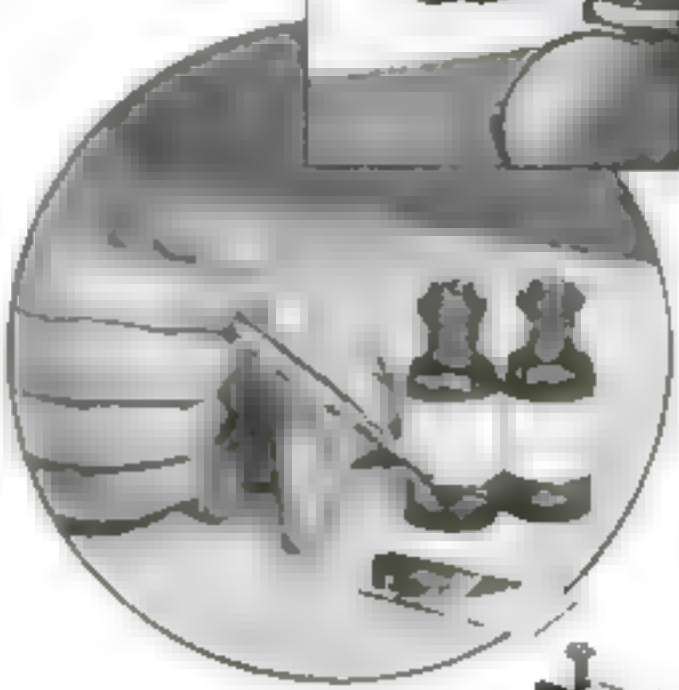
To find the mycetozoa, we enter the woodlands and seek a low, damp spot where rank vegetation is growing about fallen and decaying trees. Such is the home of the mycetozoa, of which there are some 500 classified varieties. It should be kept in mind that the tiny animal we seek has several forms and the microscopist must be able to recognize the one that is most easily found. On the surface of decayed logs look for a white slimy substance known as plasmodium, which is a mass of protoplasm formed by tiny organisms and strongly resembling the white of an egg. We may be fortunate enough to find it on the surface of a log, or if not there, we may have to dig into the wood beneath the bark to find it living in strange active colonies.

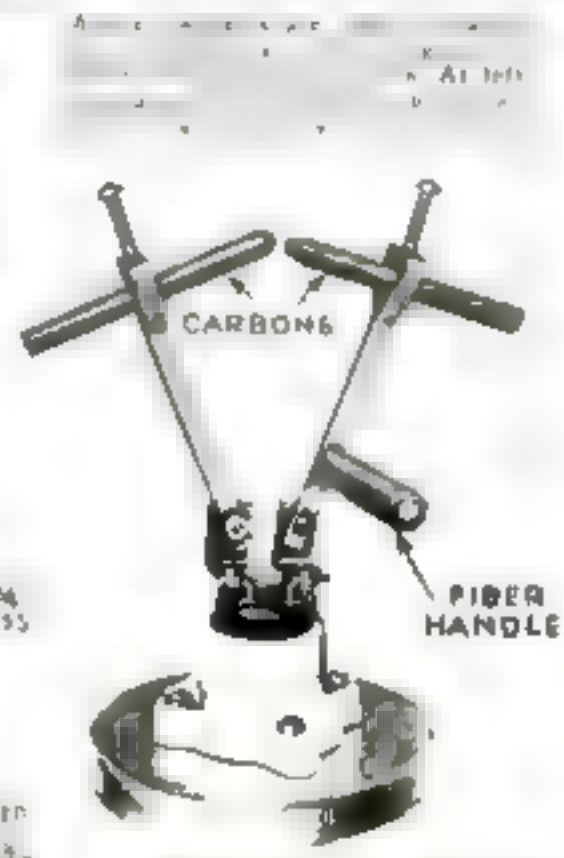
Of course it can be seen with the naked eye and may be found in patches a foot square. This plasmodium consists of a family of mycetozoa in its most important life stage. If the hunter has time to spare and will watch this mass, he will see that it has the power of locomotion. As a matter of fact, it is composed of a large army of a particular kind of mycetozoa that is characterized by the tendency to congregate in this strange manner.

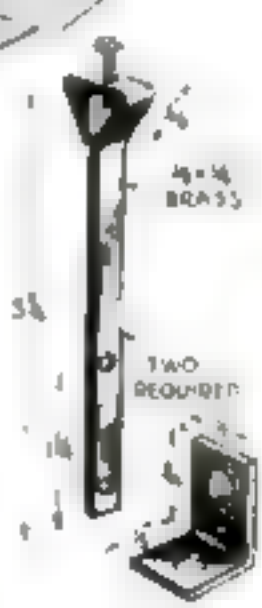
For the purpose of capturing a number of the family, we have brought with us a clean piece of white blotting paper. When the plasmodium is found, the paper is dampened and some of the slimy substance is placed upon it. Arrangements must be made to protect the paper so it will not dry out while you are taking it home. If the journey is a long one and the day is hot, it will be necessary to dampen the blotter occasionally to make sure the plasmodium does not die.

with a MICROSCOPE

How Mold Forms Found in the Woods Are Studied Under a Lens . . . Staining Specimens to Make Their Structure More Easily Seen . . . Building Your Own Small Arc Lamp with which to Take Pictures







Pictures showing clearly how to construct an arc lamp of your own with which to see the tiny specimens of mycetozoa when placed under the lens of a microscope

Once home, a slip glass is prepared and some of the slimy mass is transferred to it and placed under the little 300 or 350-power objective of your microscope. If, however you have a higher-powered objective, it will be well to use it for this investigation, provided your technique is equal to the manipulation of a high-powered instrument.

Upon looking at the mass of slime and water, we see that it is made up of myriads of tiny forms each having a tail with which it swims rapidly hither and thither. These are the zoospores that represent one of the life stages of the mycetozoa cycle. The zoospores, pure protoplasm, are provided with the rudimentary organs necessary to their survival in this particular environment. In some of the common species, the zoospores have, beside their tiny tails, vacuoles which really amount to crude digestive organs. What could such a tiny speck eat? Into a fantastically imperfect mouth, these minute creatures suck various sorts of bacteria. Indeed, the patient observer will note that as long as the zoospores are in a sufficiently wet medium a constant stream of fluid passes through their diminutive systems. It is from this bacteria-laden stream that sustenance is secured.

While in the woods, we had an opportunity to pick up another form of this curious life. In logs that have reached the extreme point of decay, we may see a fine red and velvety powder. Touching it with our fingers, we find it is light and fluffy and discover that much of it will fly into the air before the slightest breath. Some of this should be taken home in a small glass bottle, placed upon a clean slip glass, and set upon the stage of the microscope. Looked at in this manner we will be surprised to see tiny red mushrooms, each sitting on top of a gossamer stem. It is this funguslike stage in the life cycle of the mycetozoa that makes scientists wonder whether it is a vegetable or an animal form.

It is from this interesting mushroom, or spore, stage that the mycetozoa get a new lease on life. The wind lifts the tiny spores and distributes them far and wide so that some are fairly sure to fall upon moist spots where the whole mysterious life cycle begins again!

Naturally in their balloon journey, millions of these spores fall upon dry soil and perish. Countless other millions, however, reach spots suitable to their existence and propagation. Immediately upon coming in contact with moist and partially decayed matter, the spore drinks water and swells up. This process we can observe directly by placing a bit upon a damp surface and watching closely. The tiny spores become larger and larger until finally they burst and out pop slimy bits of protoplasm which turn out to be zoospores. These zoospores then congregate to form the bacteria-eating masses of plasmodium.

To keep the plasmodium alive, care must be taken to see that the bits we brought back from the woods are permitted to live on a small piece of the partially decayed and damp wood to which it originally clung. If this is done we shall see, in time, that colonies of zoospores are undergoing severe changes. The masses, drying out, change form, change color, and finally we see little spores begin to appear, their number rapidly increasing until the whole mass is composed of nothing but spores. Each spore is a tough little bag made for the purpose of preserving the life of the protoplasm it contains until it can again be brought into contact with decayed vegetable matter and water.

It should be remembered that we have been observing the life cycle of some of the more common and abundant members of this large family. Indeed, the family is so large and has such a wide variety of habits that the inexperienced microscopist may fail to recognize many of them.

The million and million of microscopic mushrooms that are produced from the plasmodium offer an absorbing course of study. Before they are fully matured, we see that they range in color from silver to pink, and resemble, under the glass, a basketful of lovely pearls. This exquisite stage, however, is of brief duration. If they are maturing in the proper medium, we shall see that, in some mysterious way, they appear to take root while slender, delicate little stems support them. Next, important changes occur and the beautiful luster of the skin is destroyed. Pocks and lines appear and we see what looks like a *(Continued on page 93)*

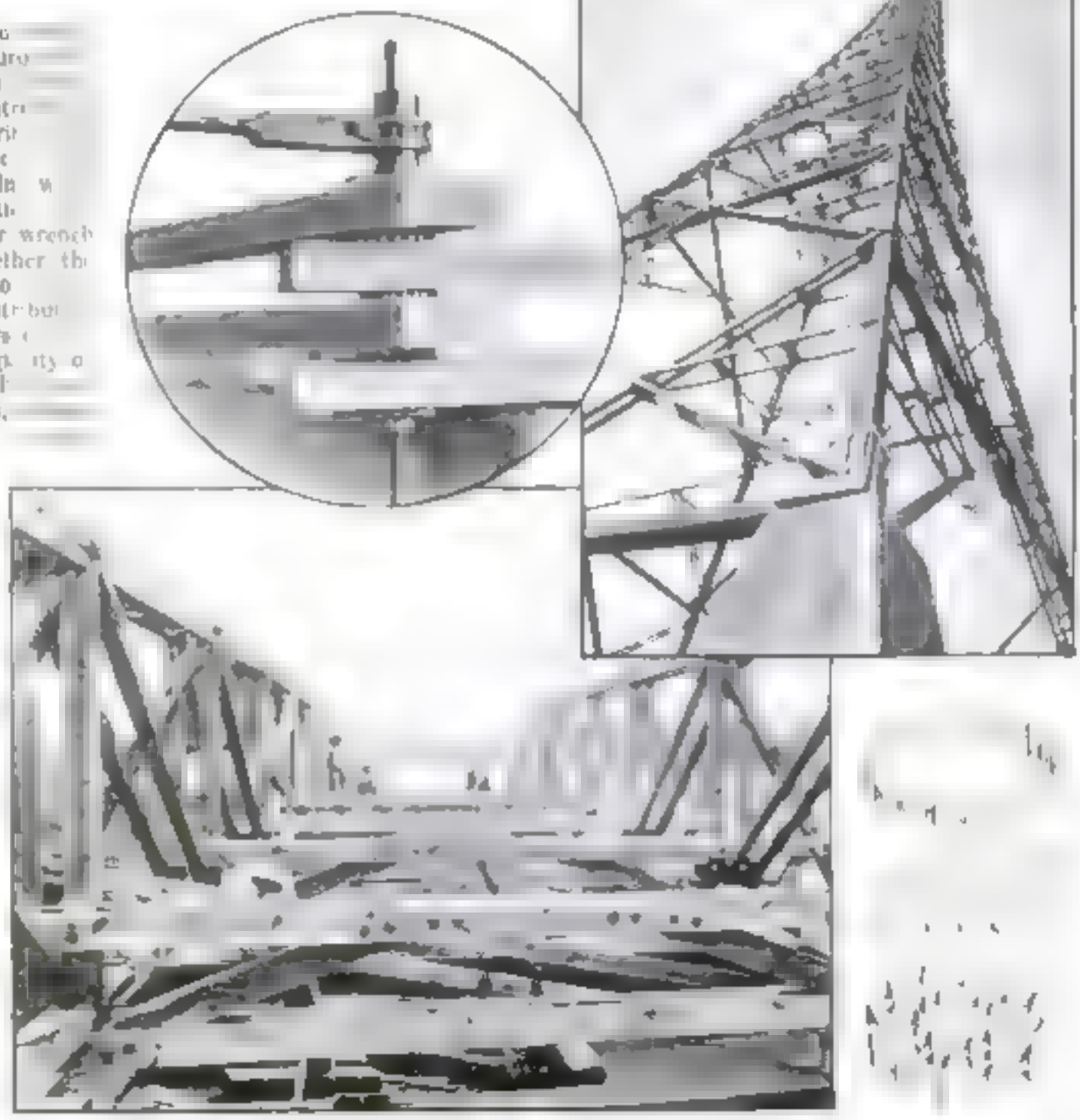
Helicopter to Fly Travelers from City to Airport

Designed to carry passengers between airport and city, this new French helicopter is expected to be able to rise or descend vertically or hover over one spot so that it can use roofs for landing or taking off

To TRANSPORT passengers swiftly between the city of Paris and its outlying airports, France is experimenting with a helicopter taxi. Capable of hovering motionless in the air and of rising or descending vertically, such a craft could land on a rooftop in the heart of the city. Attempts to build a practical helicopter have hitherto met with difficulties, but officials have high hopes for a craft just completed at the government aerotechnical laboratory near Paris by an engineer named Florion and patterned after the experimental machines of Raoul Pescara, pioneer helicopter designer. Two twenty-four-foot propellers, powered by a 200-horsepower motor will lift the plane.

CONNECTORS CUT WOOD BUILDING COST

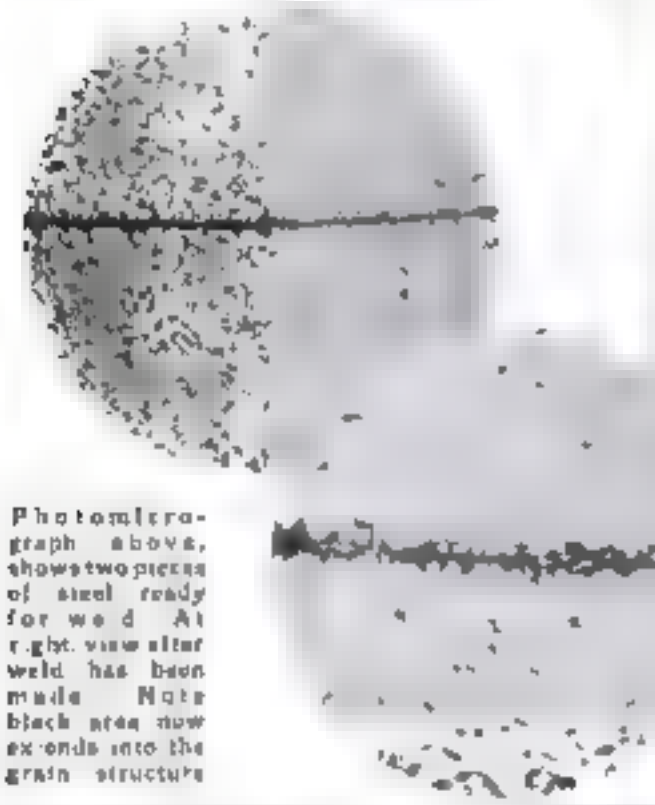
LITTLE spiked rings and disks already successfully applied in Euro joining the timbers of wooden and buildings, are now being intr in this country. American authori these devices, known as "connecto most important development in w construction in a century. Appli the aid of a hydraulic or screw wrench when the timbers are bolted together, th connectors bite into each piece o forming a rigid joint and distribu stresses through all the members o large area. The load-carrying capacity o the conventional bolted joint is th plied from four to twelve times, possible the erection of cheap structures with it is claim virtually the strength of stee Huge public halls, airship hangars, and 500-foot radio masts have been built entirely of wood by the new method. Realizing the importance of this new development in wood co struction, experts of the U. S. Forest Products Laboratory at Madison, Wisc., undertook, and recently completed, an extensive series of tests of the various styles of connectors. More than sixty were studied, and a recent report issued through the U. S. Department of Commerce shows seven or eight of these types particularly promising for American use.



By use of the three types of connectors, seen at extreme right, and which are applied with a ratchet wrench as shown in circle, the mast and bridge, seen here, were built of wood

Electric Furnace Welds Without Flame

WELDING without flame or arc is the startling feat made possible by a huge electric furnace fired with hydrogen gas, said by its Detroit, Mich., builders to be the first available to industry. Copper wire or "paste," applied to the seams of parts to be welded, melts in the 2,100-degree heat, yielding a joint of copper and [illegible] stronger than the [illegible] hydrogen prevents [illegible] thousand parts are [illegible] car-load is turned [illegible]

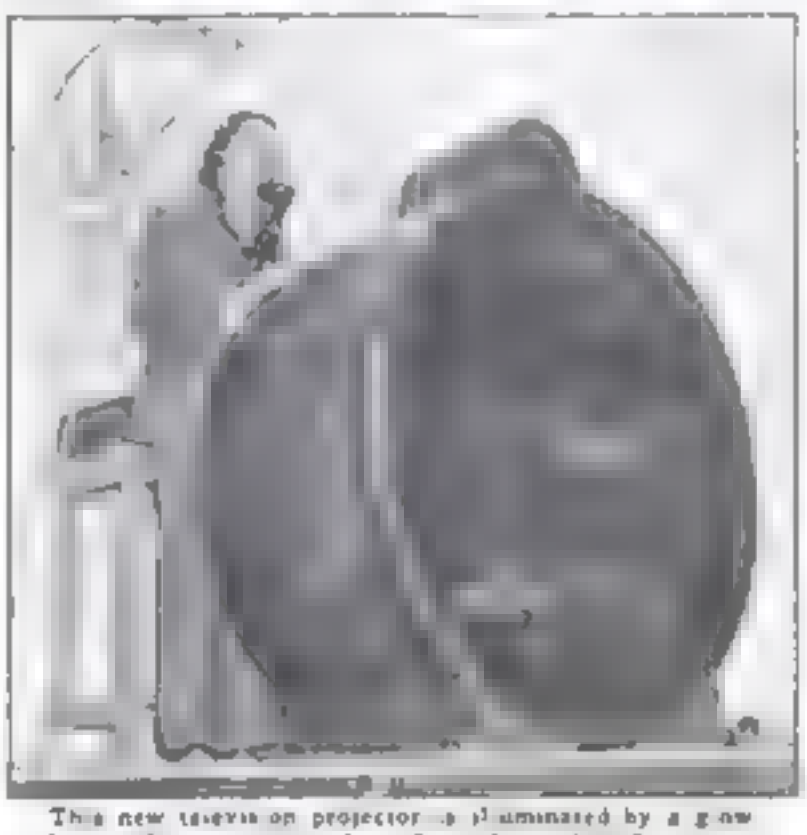


Photomicrograph above, shows two pieces of steel ready for weld. At right, view after weld has been made. Note black area now extends into the grain structure

This giant electric furnace turns out a carload of welds every four minutes, thousands of parts being welded at a time. It is this process that makes the welds seen at left

NEW PROJECTOR FOR TELEVISION

SHAPED like a monster searchlight, a new television projector demonstrated in New York recently throws unusually bright images of far-away scenes on a screen six feet high and four feet wide. The secret of its intense white light is a glow lamp employing the incandescence of heated carbon dioxide vapor, concealed within the housing for the big scanning disk. Rivaling the conventional arc light in brilliance, the new lamp flickers sufficiently rapidly in response to the fluctuating impulses, to be of service for television. The apparatus was perfected by U. A. Sanabria, Chicago inventor.



This new television projector is illuminated by a glow lamp that employs heated carbon dioxide vapor

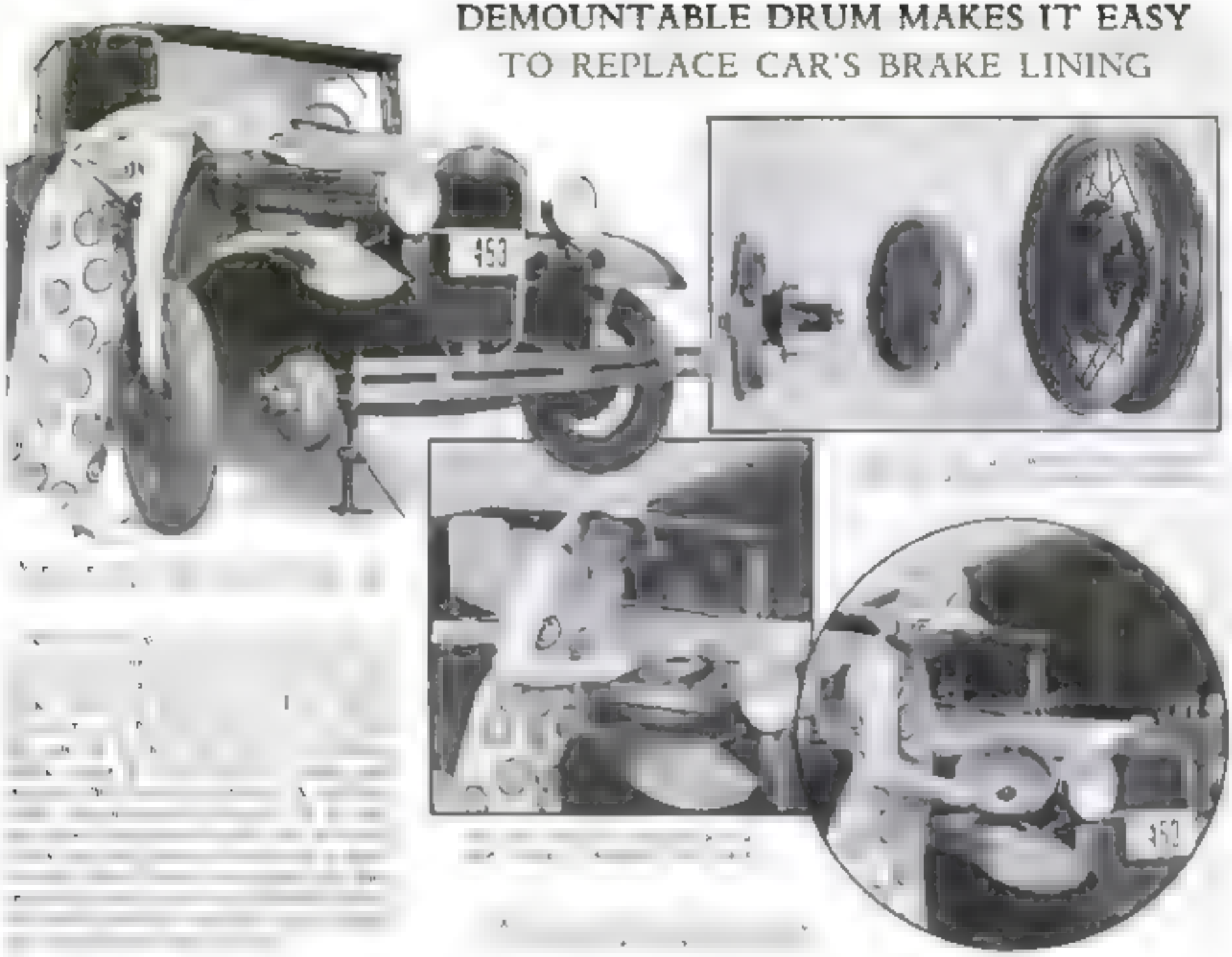
USES CAR'S EXHAUST TO WARM STEERING WHEEL

TO KEEP a motorist's hands warm despite the cold of winter, a California inventor has produced a hollow steering wheel, made of aluminum that is heated by the exhaust from the motor. A pipe leads from the exhaust manifold to the wheel, through which the hot vapors circulate. They are then led off through a second pipe and discharged through the exhaust outlet. The photograph below shows the wheel removed from the steering post to reveal the heating pipes.

STRANGE MALE TOAD IS MIDWIFE TO THE EGGS

CONSIGNED to the American Museum of Natural History, four live specimens of one of the strangest of toads recently arrived in this country. Untroubled by maternal responsibilities are the females of this species, known as the "midwife toad." It derives its name from the fact that the male assists the female in laying the eggs, and then carries the egg capsules on his back, as shown in the photo at left until they hatch three weeks later.

DEMOUNTABLE DRUM MAKES IT EASY TO REPLACE CAR'S BRAKE LINING



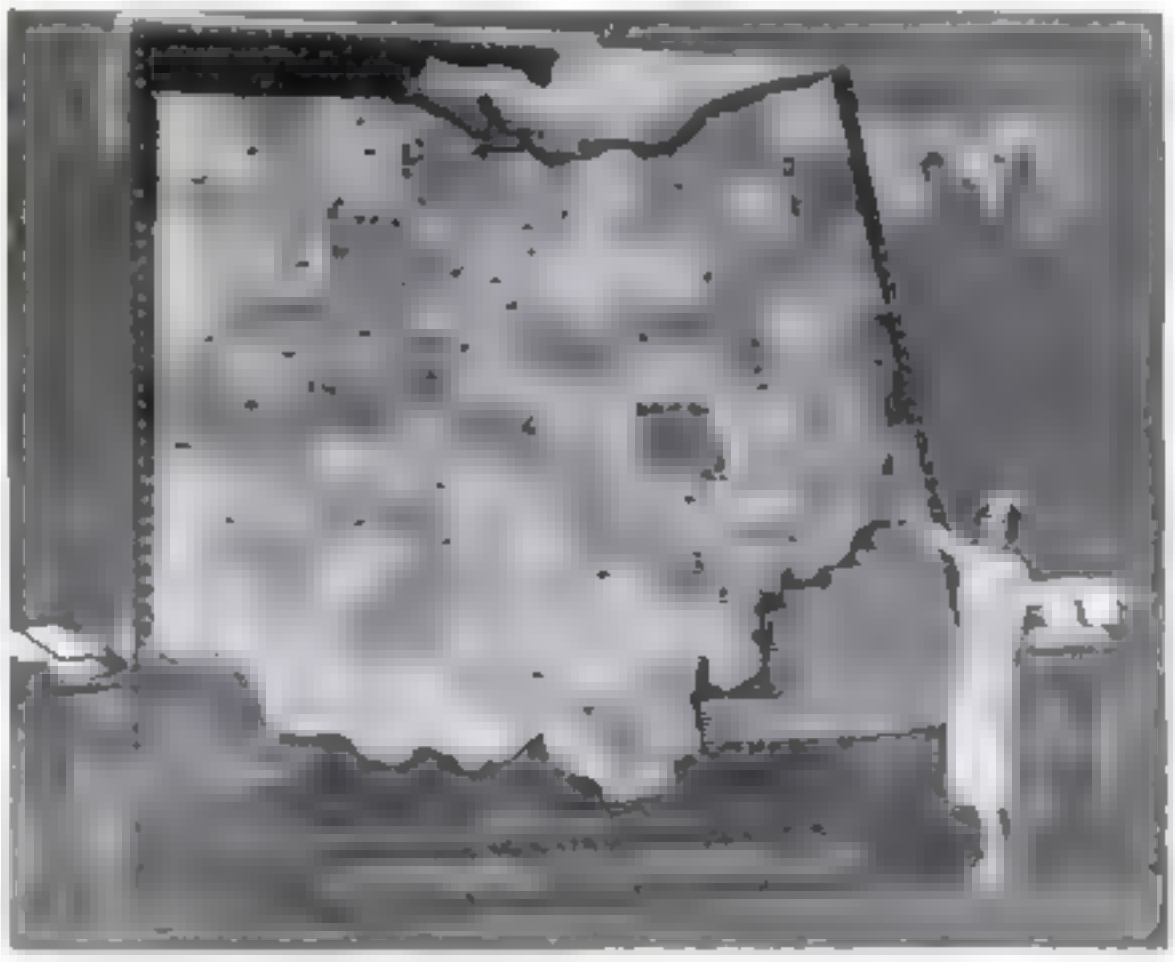
The machine, looking like a cream separator, freezes the water out of milk

FREEZING GASES TAKE WATER OUT OF MILK

To avoid damaging the flavor of milk and fruit juices, they are now concentrated by freezing instead of by heat. While the liquid is whirled in the centrifuge shown above, freezing gases are blown against it. Excess water turns to snow and is thrown from a spout at the top, while the concentrated liquid, which is almost wholly free of water, is drawn off at the bottom.

BIG MAP OF OHIO AT WORLD'S FAIR

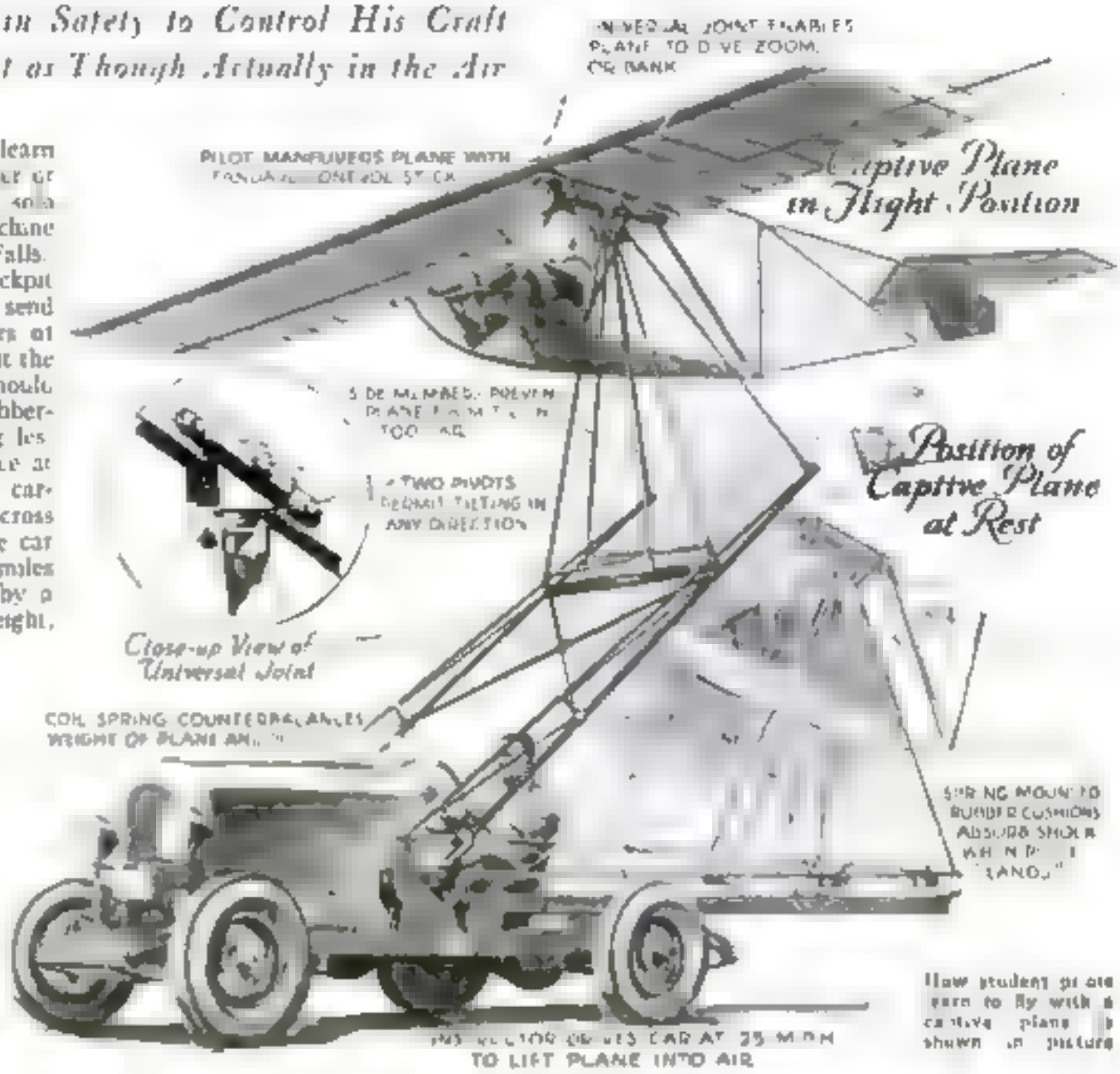
Ohio's geography is explained to Worlds Fair visitors by a mechanical map of pressed wood and glass, twelve feet square, provided with 1,502 indexed push buttons. To find any city, river, or point of historical interest the user pushes a button and one or more squares are instantly illuminated.



Plane on Motor Car is Short Cut to Flying

Student Learns in Safety to Control His Craft and Maneuver It as Though Actually in the Air

So THAT a student pilot may learn the feel of the controls of a glider or airplane before he risks his first solo flight a foolproof training machine has been designed by a Beaver Falls, Pa., inventor. Seated in the cockpit of a captive plane, the pilot may send his craft through the maneuvers of diving, banking, and zooming but the worst that can befal him if he should crash is a gentle bump on rubber-padded cushions. For a training lesson, an instructor takes his place at the wheel of a motor truck that carries the machine and starts it across the airport field. As soon as the car reaches a speed of twenty-five miles an hour, wind pressure aided by a coil spring serving as counterweight, is sufficient to raise the captive plane and its pilot into the air. While the pilot puts his craft through its various evolutions, the instructor checks up on his ability and his weak points. If a sudden gust strikes the machine or if the pilot jams over his controls too suddenly snubbers curb the maneuver and springs come into play to absorb the jolt. The instruction the student receives is identical with that he would get if the machine were actually flying but he learns without running the danger of a crash.



How student pilots learn to fly with a captive plane is shown in picture

INSECTS SHOW COLOR PREFERENCE

THAT insects, like people, have marked preferences for certain hues is the discovery of Prof. W. B. Herms, University of California entomologist. Placing them in a cage where they were free to fly toward windows of different colors, he found salt-marsh mosquitoes especially partial to blue-green light, while violet light lured the fresh-water variety. Red and yellow attract many night-flying species, while day flyers usually prefer blue the tests show. Applying his findings Prof. Herms has devised electric traps with colored lamps to attract the insects

Lamp in trap, above, attracts insects by its color. At right a test cage in which insects sought windows at, according to their preference for certain colors

SPEEDOMETER ON BACK OF CAR IS GARAGE AD

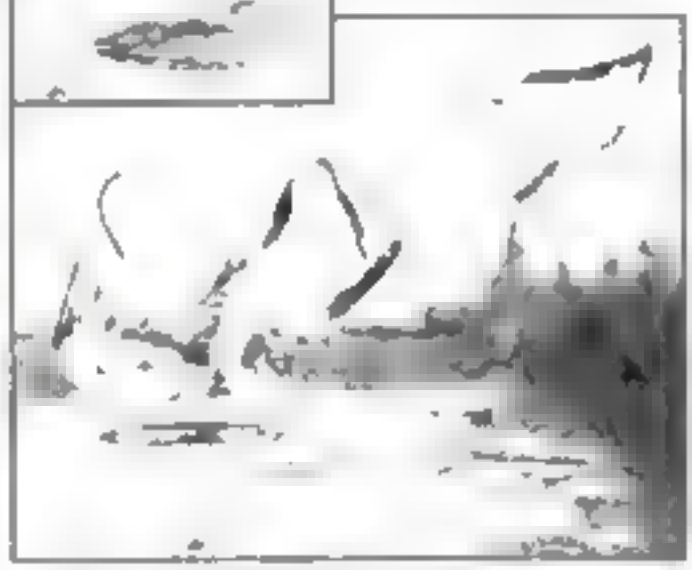
INSTALLING a monster speedometer in the back of a car, as illustrated above, so that its reading will be plainly visible from the rear is the latest way of advertising garage service. A legend on the dial reads, "How's your speedometer?", inviting the driver of a following car to keep pace while he compares his own instrument with the speed-indicating pointer. Carefully calibrated for accuracy, it permits a quick and satisfactory check up.

X-RAY MACHINE FOR FACTORIES

SITTING beside a conveyor belt [illegible] operator with a fluorescent screen [illegible] can look through [illegible] metal or wood with a portable X-ray apparatus which recently reached the United States. The new machine, shown above, is sheathed in lead. When its discharge tube was pointed toward the side of a ship, the rays showed [illegible] pieces out of line

AMATEUR TAKES PHOTOS AT LIGHTNING SPEED

USING a standard make of hand camera, a Brooklyn, N. Y., amateur photographer rivals the feats of laboratory experts with their ultra-high-speed photographic apparatus. One of his remarkable photos, at left, shows a bouncing milk bottle bending like rubber after the lower right-hand corner struck the ground. Another bottle broke when dropped from the same height, and the picture below shows the pieces starting to fly. Both views were made with exposures of 1/1,000th of a second. The photographer says similar pictures can be taken by any amateur who has a fast camera



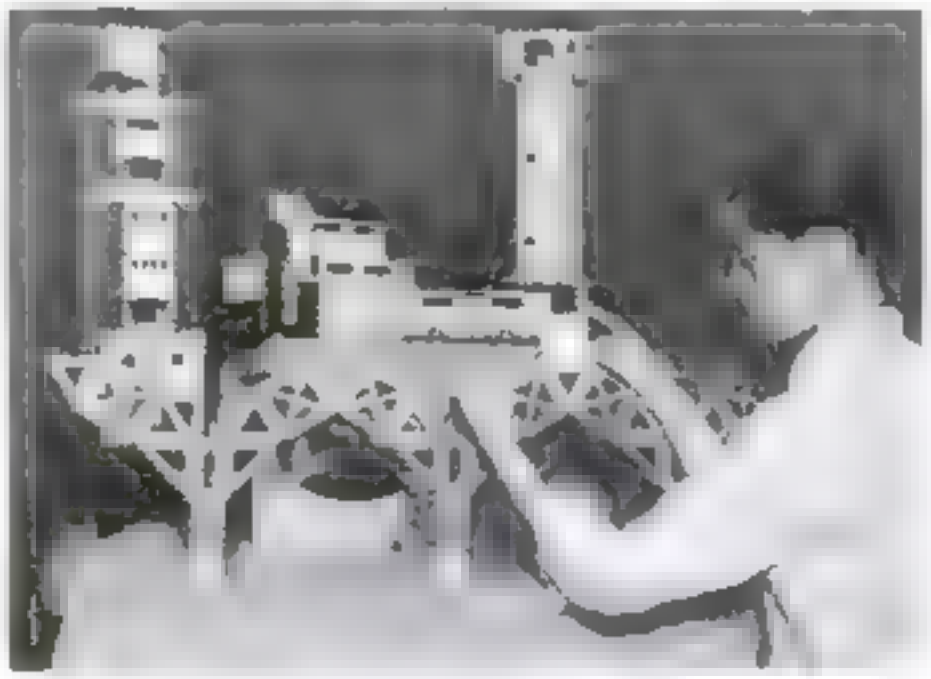
Photos of bouncing and breaking milk bottles made by an amateur with a standard hand camera

POCKET TOOL CUTS AND CRIMPS ARMORED CABLE

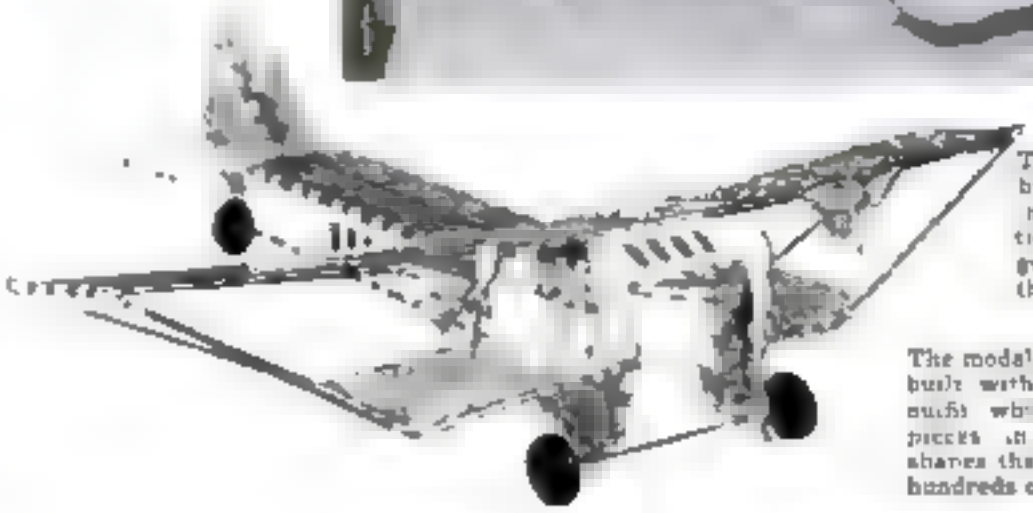
CUTTING and fitting armored electric cable is made easy by the new pocket tool illustrated above and to be the first developed especially for the purpose. When a loop has been raised in the armor by a twist of the hands, it may be cut by the jaws of the tool. Then, to prepare the cable for its connectors, the tool is used to tuck under one end of the armor strand, while the other end of the section is crimped in a socket designed for this purpose at the base of the pliers.

WIRES HOLD PIECES IN BUILDING SET

STEEL parts of twenty patented shapes, in a new toy construction set, may be assembled to form skyscrapers, bridges, [illegible] houses and hundreds of other models. Each part is bordered by a row of metal loops, and is joined to the next piece by slipping a wire pin through the loops



This bridge is being built with the pieces in a new construction set whose parts go together as do the hinges of a door



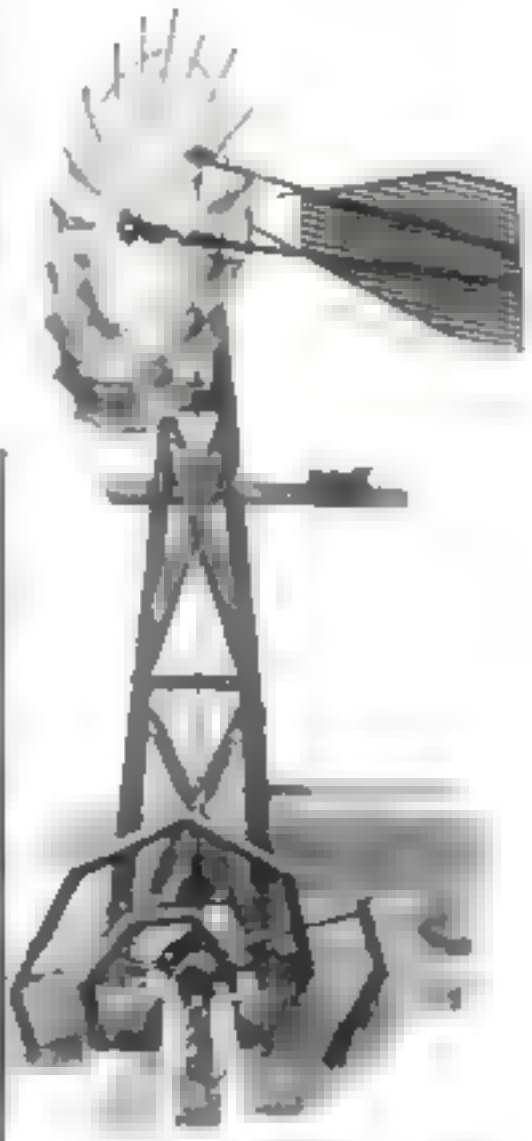
The model airplane, left, was built with the toy building outfit which contains steel pieces in twenty different shapes that offer a choice of hundreds of different designs

COIN-IN-SLOT REVEALS MICROSCOPIC WONDERS

Aware of the wide-spread interest in wonders of the microscopic world, an ingenious inventor of Oelwein, Iowa, has devised the coin-operated microscope illustrated above. By dropping a penny in a slot, the user may look through the lens at any one of ten subjects displayed on a rotary disk. A printed description of each of the subjects is mounted on top of the case, and the one desired is selected by turning the disk with an outside knob before the coin is inserted. And electric light automatically illuminates the subject.

CHINESE WINDMILL WATERS FARM

Adapting an Oriental idea for raising water for his own needs and to irrigate his fields, a California farmer has constructed the curious apparatus shown in the accompanying photographs. Power from a windmill, transmitted through gears, revolves a spiral-shaped tube of pipe open at both ends. The outside end dips into a water-filled ditch at each revolution. Water is thus picked up, and runs by gravity around the spiral to the hub as the wheel revolves. An opening in the hub discharges the water into a trough four feet above the level in the ditch, giving a sufficient lift for the irrigation purposes desired.



Windmill used to pump water, for irrigation purposes, by means of the curious spiral pipe, open at both ends, of which a close-up is shown in the picture at left.

RARE BOOKS COPIED WITH A CAMERA

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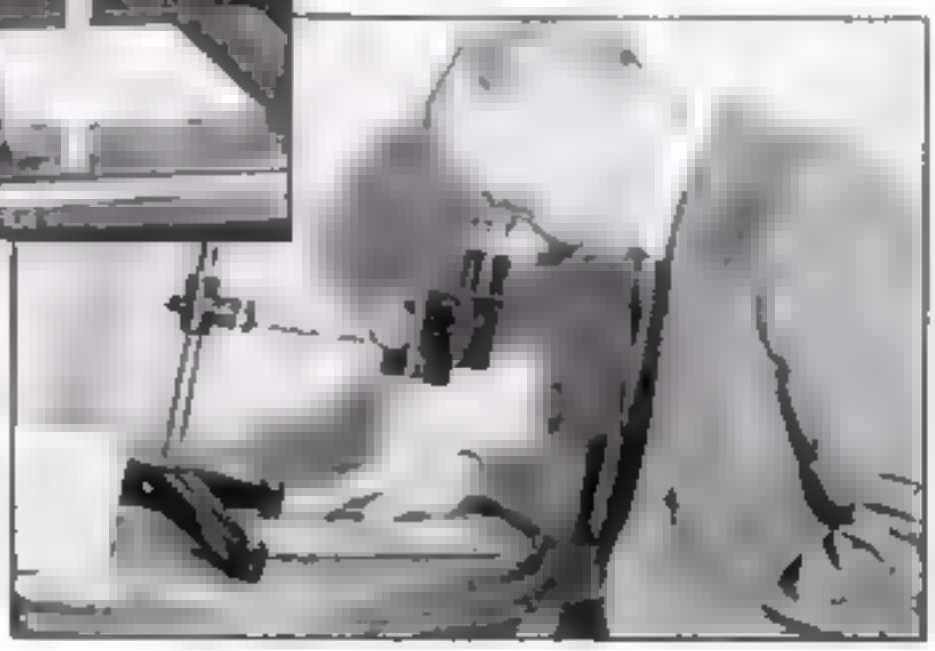


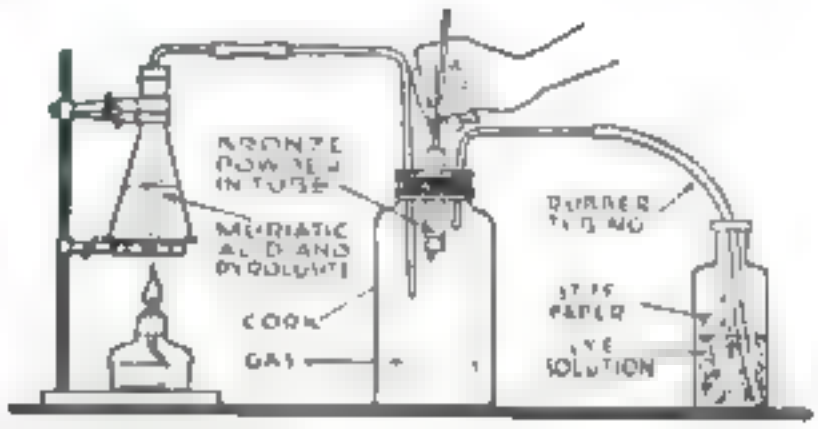
A[illegible] ing the fro[illegible] [illegible] abo[illegible] w[illegible] of rare [illegible] are made. The pho[illegible] pied pages, [illegible] in groups, as a [illegible] are read with the aid of binoculars.

DIRIGIBLE PROPELLED BY BLASTS OF AIR

Looking toward the future of airship design, a Congressional committee recently studied the feasibility of building a dirigible devoid of all external propelling and steering mechanism. A working model submitted to it, illustrated above, showed how such a craft could be propelled by concealed motors, sucking in air through the nose of the ship and discharging it in a rocket-like blast at the rear. According to the inventor, steering could be effected by shifting the angle of the discharge tube,

HOME TESTS *show*

Strange Nature of Chlorine



HOW TO MAKE METAL FLAME

With your apparatus set up as shown at left, and in the illustration above place gold bronzing powder in the corked tube in the center. When the gas in center jar becomes green force the cork out of the tube so powder drops into jar. As powder strikes the chlorine, it will flash

UNTIL you experiment with chlorine you have missed some of the biggest thrills your home laboratory can give you. Among other things, you can make metals burst mysteriously into flame, remove the color from dyed cloth, and turn a red flower or a scrap of red paper white.

Chlorine, a heavy greenish-yellow gas, is exceedingly active. Few substances can remain uncombined in its presence. Even silver and gold yield to its action under certain conditions. With many elements, it combines with such suddenness and violence that intense heat and a brilliant flash of light accompany the reaction.

Considered in one way, chlorine is one of the paradoxes of science. Inhaled in small doses it is said by some physicians to be beneficial in the treatment of colds. Yet, if it is breathed into the throat and lungs in large quantities, it is poisonous, causing irritation and violent choking. In an atmosphere containing as little as one part of chlorine to 10,000 parts of air, breathing becomes acute and painful.

However, the amateur chemist need have no fear of being gassed during his simple experiments with chlorine. For by means of a simple arrangement, he can effectively absorb all of the unused gas and prevent it from escaping into the air.

Commercially, chlorine gas is made by the same electrical process used in our recent experiments with the treelike crystals of tin (P.S.M., Dec. '32, p. 59). In place of the tin solution, however, sodium chloride (common salt) is used. The passage of the direct current through the solution produces free chlorine at the positive electrode and hydrogen at the negative pole.

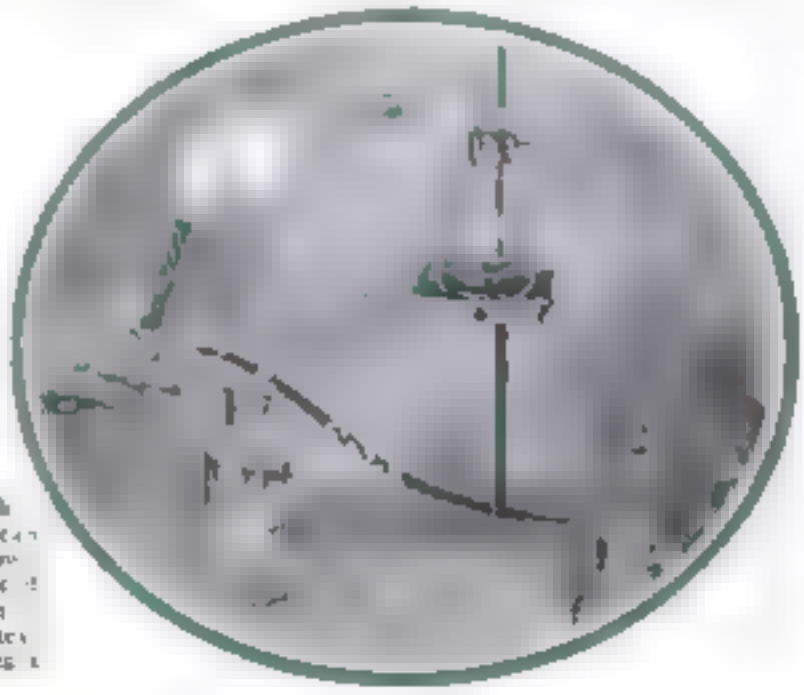
In the home laboratory, the amateur can manufacture the chlorine simply by heating a mixture of muriatic (hydrochloric) acid and manganese dioxide (mineral pyrolusite). If the manganese dioxide is not easily obtainable, potassium permanganate or potassium dichromate will serve the purpose just as well.

In our first experiments with chlorine gas, the gas-tight apparatus shown should be used as the generator. In it an L-shaped glass tube leads the free gas from the heating flask to a wide-mouthed bottle (a large pickle jar will serve). From there it is piped to a third jar containing lye solution open to the air. The center jar forms the experiment chamber while the last container is the scrubber or absorber for the unused gas.

The scrubber is an important part of the apparatus and should not be omitted. It absorbs the unused gas passing from the experiment chamber and prevents it from contaminating the air. To offer a greater absorbing surface for the gas, wet a crumpled ball of stiff paper with the lye solution and immerse it in the bottle. If by any chance you should get a strong whiff of the free gas, you can relieve any unpleasantness by inhaling a cohol.

If you find that the system leaks, plug up any small holes and cracks with putty or wax. Of course, if you desire, you can perform the experiments out of doors, substituting a small alcohol lamp for the gas burner under the generator.

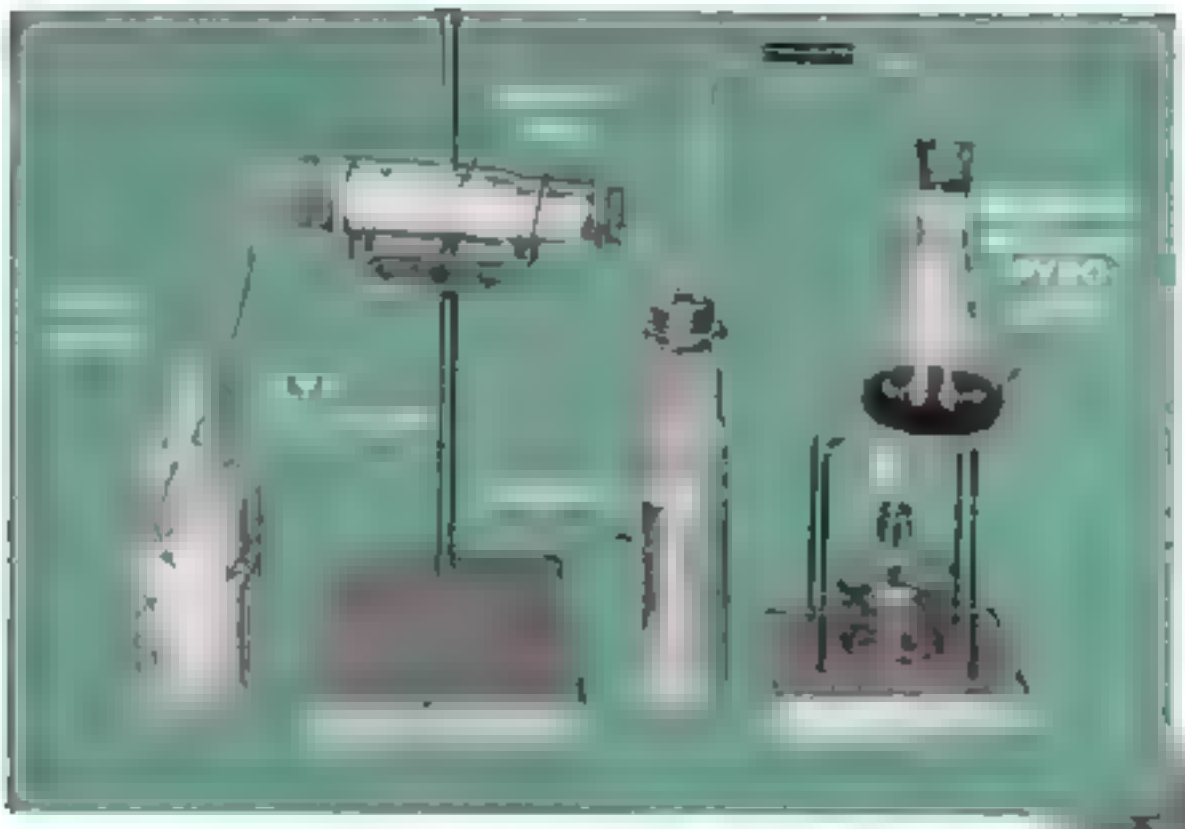
Since the center jar is our confined experiment chamber, some means must be provided for inserting the chemicals whose action with chlorine is to be tested. This can be done by punching a third hole in the center of the cap or cork and inserting a glass or metal tube two inches long, corked tightly at its lower end. Powdered metals then can be placed in



That mercury will glow when heated in chlorine gas you can prove with the apparatus shown here. A drop of mercury is placed in the test tube into which chlorine gas is flowing. When the test tube is heated a glow appears

How to Make Metals Flame and Why Red Flowers Turn White is Explained Here

By
RAYMOND B. WAILES



MAKING BLEACHING POWDER This set-up shows how bleaching powder is made on a big go scale. As the generator flask, at right, is heated, chlorine bubbles through the bottle of water and passes over the lime which becomes a bleaching powder

The illustration above shows how chlorine is made on a commercial basis by passing a current through salt solution. At right is shown a thermometer with wet paper around bulb to measure the heat when hydrochloric acid gas dissolves in water

the tube and the cork pushed out when the chamber has filled with chlorine.

We can try out our apparatus by placing some "gold" bronzing powder in the entry tube. Heat the mixture in the flask to generate the gas and as soon as the center bottle takes on a greenish color, showing that it is filled with chlorine, push down on the metallic powder and force the stopper out of the short tube. As the powder drops into the jar and combines with the chlorine, it will flash vividly.

Using this same apparatus try other metals in powdered form. In the case of brass, you may find that it will not burn violently in combining, but you will know that a reaction is taking place by the fact that the powder will turn green.

Some metals will not combine with chlorine at ordinary temperatures. Mercury and copper foil are excellent examples of this type. You can demonstrate this by piping the chlorine direct from the heating flask to the lower end of a test tube containing a drop of mercury. The chlorine and mercury will combine only when the base of the tube is heated. When the proper temperature is reached, the mercury will vaporize and a soft blue glow will appear at the end of the entrance tube. In effect, it will appear as if the gas is burning as it issues from the tube. As the process continues, the walls of the test tube will become coated with crystals of mercuric chloride, a poisonous corrosive sublimate. Similar reactions will occur when other metals are used.

In this experiment it is also important to arrange some means of absorbing the unused chlorine gas. This can be done by providing the test tube with a rubber stopper containing two short tubes, one going to the heating flask and the other to a scrubbing bottle filled with the lye solution and crumpled paper.

Like many of the other gases, chlorine is particularly soluble in water. It dissolves readily to form chlorine water, a mixture of hydrochloric and hypochlorous acids. Both chlorine and chlorine water show a useful property in their ability to bleach the color from certain dyes. The red portion of an empty match box, for instance, can be bleached simply by immersing it in chlorine water or by inserting it wet in a closed beaker of the gas.

In reality, the bleaching property of chlorine and chlorine water is not due to the chlorine but to the *oxygen* liberated from the hypochlorous acid. The oxygen oxidizes the coloring matter and changes its structure. This same action makes chlorine valuable as a purifying agent for water.

Bleaching powder, an important industrial chemical, can be made easily in the home laboratory by passing chlorine gas over moist lime (calcium hydroxide). To do this, the amateur can make up a simple piece of apparatus from odd bottles, corks, and tubing. Our old friend, the bottomless olive bottle also comes back into use as the reaction chamber.

The chlorine gas generated in a flask is piped first to a bottle of water, which serves as a scrubber to remove any hydrochloric acid gas mixed with the chlorine, and then to one end of the olive bottle. Pack the olive bottle with moist lime, mount it horizontally, and fit it with corks. The exit end of the reaction chamber should lead to the lye solution scrubber or absorber.

To perform the experiment, simply heat the generator flask. The chlorine evolved will bubble through the water bottle and pass over the lime. Some of the chlorine will dissolve in the water but soon the saturation point will be reached and the gas will pass on to the reaction tube and the moist lime.

Continue to heat the mixture in the generating flask until the greenish-yellow vapor disappears entirely. This will mean that all of the chlorine gas has been driven off. The chemical remaining in the horizontal tube will be bleaching powder.

Mixed with water to form a paste, it can be used as a (Continued on page 97)

Inventions *for the*

ASPARAGUS COOKED STANDING UP. A bunch of asparagus is placed in an upright position in this aluminum cooker in which there is boiling water. The low heavy stalks are thus boiled and the tender tops are cooked in the rising steam. In this way the full flavor of the asparagus tops is retained

DOUBLE-ACTION SEWING MACHINE The electric sewing machine, above, is equipped with controls that regulate the length of the stitch while a shift lever enables the user to sew either forward or backward at will. A speed control makes it possible to sew fast or slow

HOME DRINKING FOUNTAIN Clipped to any household faucet, this little device serves as a drinking fountain. It consists of a small U-shaped trough of metal that deflects the water upward as is shown in the photo below. The metal parts in contact with the water are said to contain germicidal properties because of special treatment

GUARDS AGAINST MOTHS The cardboard chest seen below contains a special paper, treated with oil of cedar, a repellant that keeps the moths away

GLASS HOLDER The metal coaster above not only holds the tumbler but also has a built-in receptacle for cigarette ashes. Ridges on the coaster prevent it from sticking to glass when latter is lifted

NEW EGG BEATER Clamped firmly to the wall, the egg beater at right has flanges that grip and hold the egg bowl. When the bowl is in place, one has only to turn the handle to get well beaten eggs

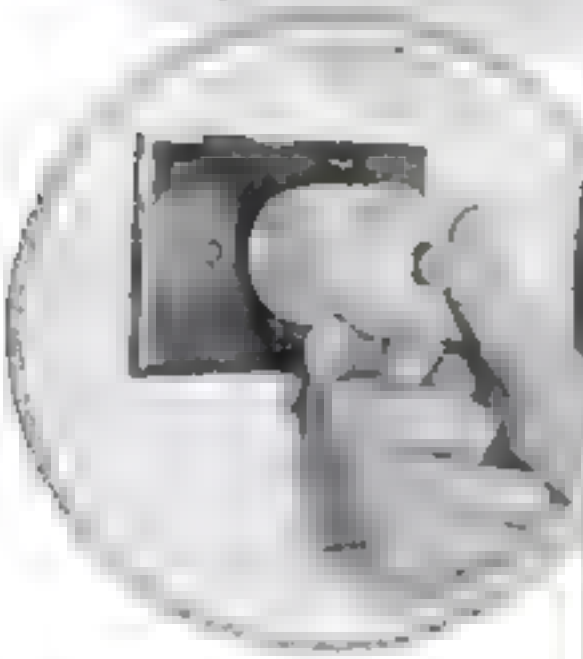
REPAIRS BURNED-OUT TOASTER When the heating element in a toaster or similar device burns out, it is repaired with this sleeve that unites ends

GLASS COFFEE PACKAGE Vacuum-packed in glass, the coffee in this package can be inspected by the purchaser. A slot in the top opens the jar

Household

WASHES DAINTY SILKS. Frag[illegible] silk stockings are safely and easily washed. [illegible] is used with the pan of hand pad[illegible] illustrated below. The garments are dipped [illegible] and rubbed with the [illegible] to get the dirt

MEALS IN ONE CONTAINER. [illegible]



[illegible] NIGHT LIGHT. [illegible] by washing [illegible]

EARNING MADE EASY. [illegible]

[illegible] COOKIES. [illegible]

[illegible] KEEP FRESH. [illegible] which are [illegible] page

MENDS BROKEN CROCKERY. Free from un[illegible] cement makes it easy to mend broken plates or crockery. Originally developed for use in glass, the cement is now available for household use. It can be applied easily

VACUUM CLEANER KILLS MOTHS. By reversing the action of the air flow in the vacuum cleaner, it is transformed into a moth chaser by sucking out vapors from a receptacle of moth crystals. The revolving mechanism is built into the cleaner and is operated by turning a lever. The cleaner also has an automatic dust emptying device

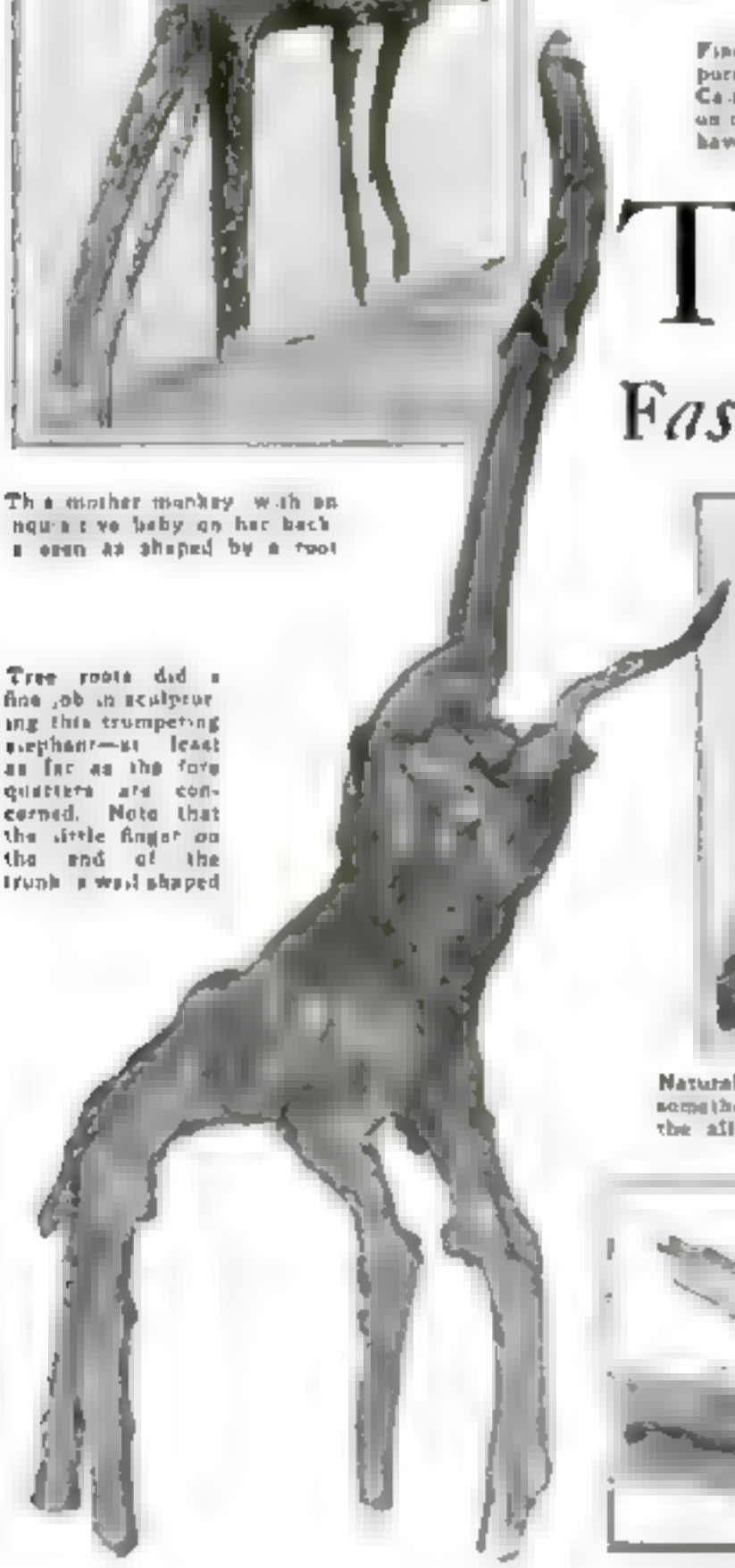
Two tree-root penguins, right look natural as life, as does the greedy pelican, mouth open, shown below

Finding tree roots that resembled birds, insects, and animals was the odd hobby pursued by Frank H. Dunn, above, during five years spent as a fur buyer in Arizona, California, and Nevada. On this page are reproduced a few specimens from Dunn's unique collection of more than fifty roots. All are exactly as they were found. Some have been mounted but none has been whittled or shaped in any other way

TREE ROOTS

Fashion Weird Animal Forms

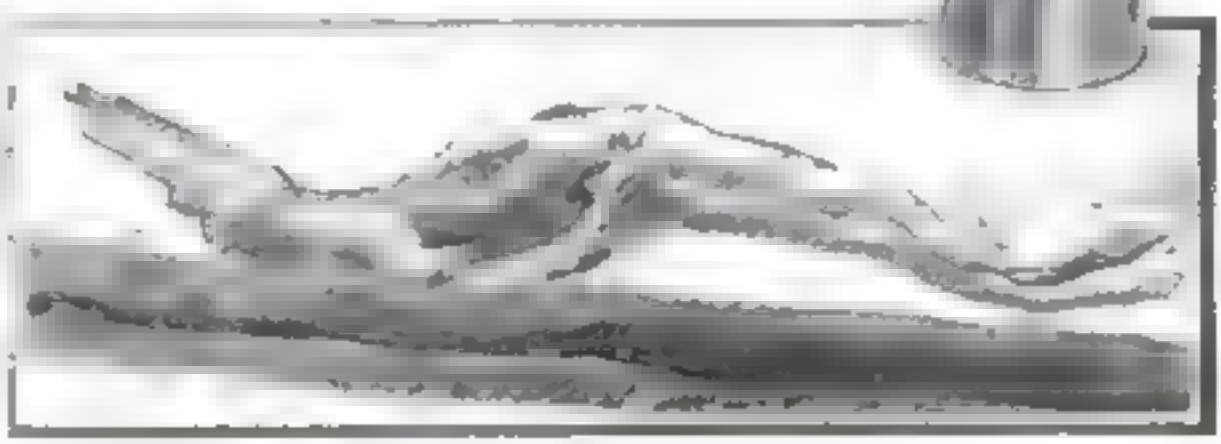
The mother monkey, with an inquisitive baby on her back, is seen as shaped by a root



Tree roots did a fine job in sculpturing this trumpeting elephant—at least as far as the fore quarters are concerned. Note that the little finger on the end of the trunk is well shaped

This trained seal, balancing a ball on its nose, is one of the prizes in Dunn's collection of odd tree roots

Natural enough as to head and neck, the antelope above leaves something to be desired in the modeling of the hind legs. But the alligator, below, is a tribute to nature's artistic knack



Weight Makes Space Winding Easy

DEVICE SPEEDS WORK ON SHORT WAVE COILS—HOW TO IDENTIFY CIRCUITS

ALTHOUGH there are many ways to space wind short wave coils, few are as simple and effective as the method illustrated. Instead of the usual spacing string, wound the full length of the coil, a simple weighted loop hung over the form automatically separates the turns the desired amount.

First attach one end of the coil wire to the form and the other end to a door knob or other convenient support. This will allow you to stretch the wire taut.

Then, using a short length of wire or cord whose diameter is equal to the spacing desired, make a loop two or three times as large as the coil form. To one end of this loop attach a weight, a fishing sinker or a large carriage bolt will serve nicely.

You are then ready to go ahead with the winding. Hang the short loop over the form in such a way that it will follow the winding as the coil is turned. To do this it will be necessary to have at least one complete turn of wire on the coil. In this position, the loop, held taut by the weight, will space each turn from the preceding turn just the required amount. Each turn of wire as it is wound should be pushed tightly against the spacing loop.

When the winding reaches the desired number of turns, simply lift the loop and slip it from the coil. The result will be an accurate, professional-looking job of space winding.—J. W. Dorr

Tags Save Trouble in Repairing Set

WHEN your set goes dead and you find it necessary to test or replace some of the parts, you can avoid trouble by following a few simple rules.

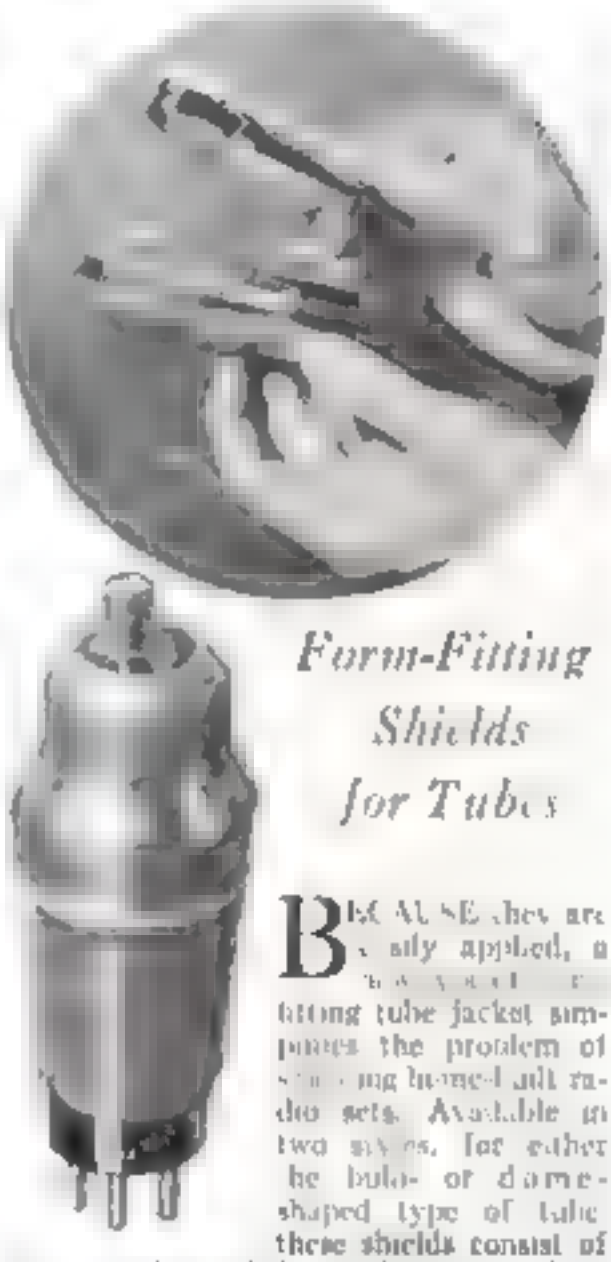
First of all, be sure to make a simple wiring diagram of the portion of the circuit where the change is to be made. This will come in handy when you start to place the substitute part. Where a number of wires must be disconnected, you can identify the loose ends with small tags or bits of paper. Place an identification letter or number on each tag and write the letter in red at the corresponding point in your diagram. Or better still, write a short description of where the wire is to be connected directly on the small identification tag.

If your receiver has faired and you suspect a resistance or a fixed condenser, do not haphazardly select one particular unit and immediately remove it from the circuit. You can save time and bother by going about it systematically, substituting equivalent units by means of your test prods.

For instance, suppose you suspect a 10,000-ohm resistor. Connect a similar resistor to your test prods, place the prod points on each side of the resistor in question, and turn on your set. If that unit is at fault the substitution of the new resistor will bring the receiver back to life. In this way, testing each unit in order, you can find the faulty part easily by the process of elimination and without unnecessarily removing good units.

For continuity tests you can use a C battery and a pair of earphones.—W. G.

Wiring diagram and tags on parts will help you in repairing set



Form-Fitting Shields for Tubes

BECAUSE they are easily applied, a [illegible] button tube jacket simplifies the problem of shielding home-built radio sets. Available in two styles, for either the bulb- or dome-shaped type of tube, these shields consist of two equal molded metal sections held in place with a small circular wire spring.

Their simplicity makes them particularly valuable to the amateur who likes to experiment. They can be applied quickly and removed easily. Various combinations of shielding for detector and radio-frequency tubes can be tried without altering the design or construction of the receiver chassis. This same quality makes them equally valuable to the radio fan who desires to improve present shielding.

A ground is provided by a small L-shaped strip of metal slipped over the cathode pin of the tube and clamped between the jacket and the tube.—B. F. O.

Getting a Good Antenna

GENERALLY speaking, the better your antenna, the better your radio reception. For best results, the antenna should be about 100 feet long and placed as high as is feasible. It need not be a continuous length of wire, but if several lengths are joined, the joints should be soldered, not merely twisted together. It is better that the antenna be insulated and bottles make satisfactory insulators. Fit the neck over the supporting post and loop the wire about it.—L. F.

HOME-MOVIE Sound Records

MADE WITH Radio Set

By *Phil Wall*

NO LONGER need the home movie fan who plays his films in silence. By using his radio to make synchronized sound records he can transform them into realistic talkies.

The recording is done on inexpensive pregrooved records. If your radio has a built-in phonograph, the problem is simplified. If it hasn't, you can equip it with an electric pick-up, turntable and microphone. When not furnishing sound for your movies, you can use the hook-up to play standard records, which can be amplified for dancing.

As shown in the drawings, only two sets of connections are required for the recording operation—one for the microphone and the other for the pick-up. The microphone circuit, consisting of a small dry battery, a microphone transformer and a microphone, can be connected to a radio's audio amplifier in several ways. In most cases, the two leads can be wired to the grid and cathode prongs of the detector tube. However, if this does not work satisfactorily, try making the connections to the grid prong and ground (on A. C. sets only) plate and cathode prongs, or through a simple jack wired to the primary of the first audio transformer as outlined in a recent article (P. S. M., Apr. '33, p. 62).

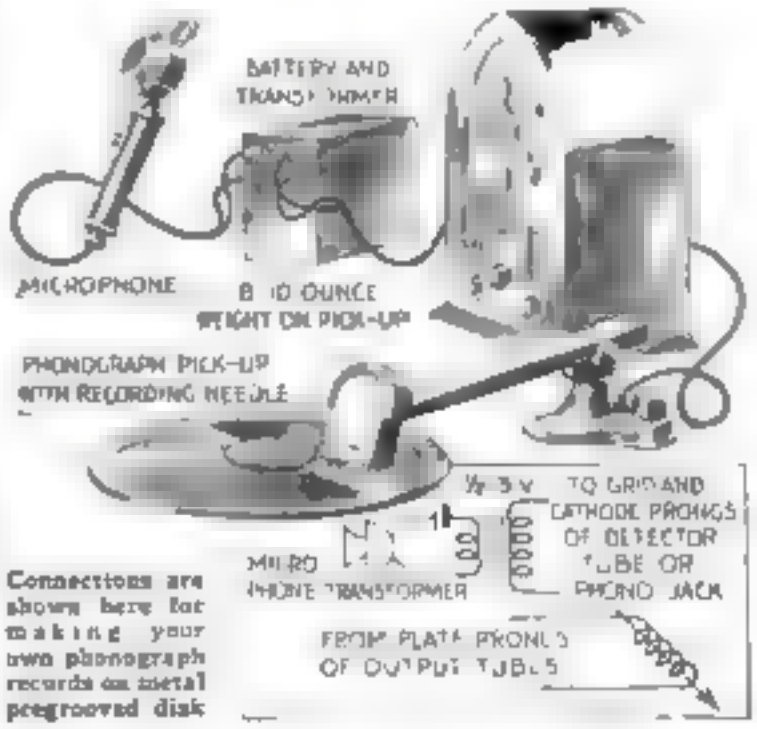
The pick-up (high impedance type) is wired to the receiver through cutting needle should be used.

To reproduce the records after they are made, the arrangement is reversed. The pick-up, provided with a soft reproducing needle instead of the recording needle, is wired to the same detector tube prongs used by the microphone when recording. The sound amplified by the receiver, then issues from the loudspeaker much the same as a radio program does.

The length of film you can supply with sound depends on the type of phonograph turntable you are using. If it is the modern, slow-revolving (33 R. P. M.) type, a twelve-inch record will last for more than eight minutes, the equivalent of 150 feet of film. The regular turntables (78 R. P. M.), on the other hand, will allow only four minutes of sound on a twelve-inch disk, enough time for a single 100-foot film roll.

After you have made several test records and are satisfied with the results, review the film to be synchronized and cut its length to match the size and type of

Weight added to pick-up in making record



Connections are shown here for making your own phonograph records on metal pregrooved disk

record you are using. Then re-show it several times and write a short script or story to go with it, making sure that each paragraph or section fits the time required to show the scene described.

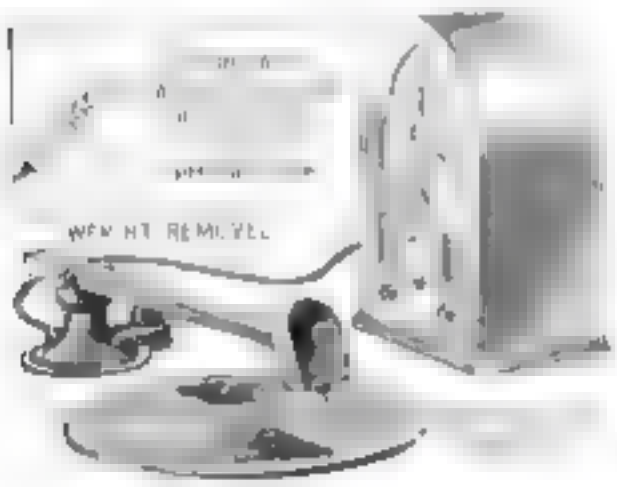
When your script is in its final shape, set up your equipment according to the illustration at the top of the page. Holding your microphone in one hand and the script in the other take a position between the projector and the screen. This will allow you to read from the story as you watch the picture.

Unless some cue word is used, it will be difficult to start both the record and the film at exactly the same moment. For this reason, it is best to preface your story with some sort of opening announcement such as: "These scenes were taken during a visit to the farm." The word "farm" being the cue to start your projector.

Thread your film and place the first picture of the first scene directly in line with the lens. Open the clutch so the film will not run and start up the projector motor to bring it up to speed. Then place the weighted pick-up with its recording needle on the outer groove on the record and start the turntable motor. When the motor reaches speed, begin your description, holding the microphone five or six inches from your mouth and speaking slowly and distinctly. At the cue word, throw the projector clutch and start the picture.

From there on it is merely a matter of speaking clearly and interestingly, gaging your speed to fit the film. At the end, you can add some appropriate closing words.

In showing your talking picture, you follow somewhat the same procedure. After disconnecting the microphone and



Connections necessary in reproducing the phonograph records are shown in diagram

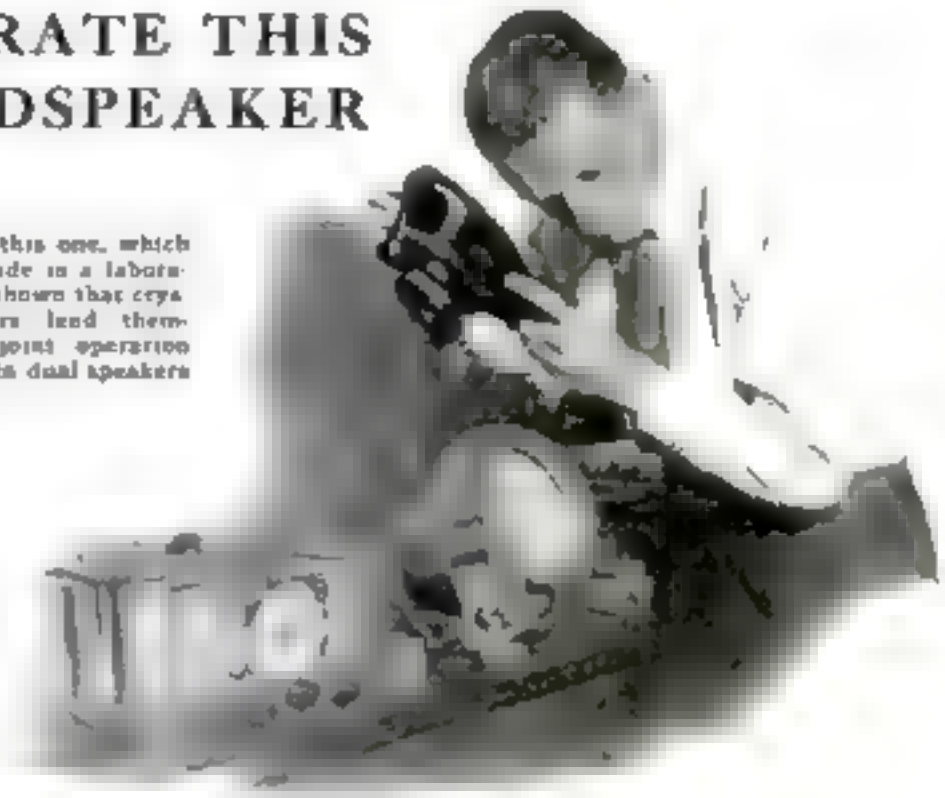
wiring the pick-up in its reproducing position, thread your film as before and start the projector motor to let it warm up. Then start the phonograph and listen for the cue word, releasing the projector clutch at just the right time.

If you care to, you can insert realistic sound effects into your recordings. For movies of crowds, for instance, several people mumbling and talking five or six feet from the microphone during your spoken description will furnish an appropriate newsreel background when the record is reproduced. In the same way, the noise of a fire can be simulated by crackling sheets of cellophane near the microphone.

While homemade talkies will not, of course, equal the professional brand, you will be surprised at the results.

Talking Crystals

OPERATE THIS LOUDSPEAKER



Tests like this one, which is being made in a laboratory, have shown that crystal speakers lend themselves to joint operation with units in dual speakers

VIBRATING crystals change electrical energy into sound waves in the latest type of radio loudspeaker. Unlike the usual type, this reproducer works without a magnet, depending on the weird property of a simple chemical for its operation.

Radio engineers have long known that Rochelle salt crystals warp and vibrate when they are placed in an electrostatic field. This strange ability, known as the piezo-electric effect, has been harnessed to form an efficient "crystal" loudspeaker unit.

Outwardly the crystal speaker resembles the common dynamic type used in present day radio sets. However, in place of the complicated mounting strap, transformer and heavy magnet, there is a shallow, circular housing containing a carefully machined slab of Rochelle salt crystals. This crystal element, cut in the form of a small square, is held rigidly in rubber clamps at three corners. The remaining corner, free to move, is connected through a pivoted tone arm to the base of a conventional speaker cone. Two thin plates fastened each side of the crystal slab form the only terminals.

As the electric impulses from a receiver's audio amplifier are impressed on these two condenserlike plates, the crystal slab, twisting and warping, sets up a definite series of vibrations. By means of the simple three-point mounting these movements are transmitted through the tone arm to the speaker cone where they are converted into sound waves.

Theoretically, crystal speakers have several advantages over either the dynamic or magnetic types. Their construction being simpler, they are less likely to deteriorate or get out of order. Also, since they require no magnet, they can be made lighter and shallower for a given size of cone. The commercial crystal speaker shown in the photographs, for instance, weighs just a trifle more than two pounds and measures less than three and one-half inches in depth.

Three types of loudspeaker construction. Photo shows the appearance of these speakers

Although the speaker shown operates on a single crystal slab, there are others, designed especially for public address and theater use, that consist of four crystal elements connected to drive a single cone or diaphragm.

These crystal speakers prove particularly well-suited for joint operation with dynamic units in dual speaker arrangements. It is claimed that such a combination is far superior to a similar system consisting of two dynamic speakers. Because they lend themselves well to parallel operation, they also are valuable in cases where extension or multiple speakers are desired.

By

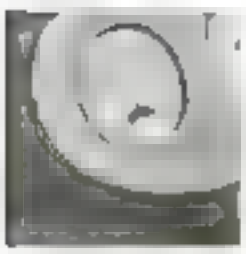
MARTIN

BUNN

What would y[illegible] about this?" Gu[illegible] as he selected a [illegible] pointed to worn [illegible] the tread. "Looks [illegible] was weak to beg[illegible] Canton replied [illegible]

Plain Clues to Motor Ills

Many Things You Can Learn About an Engine by Using Your Eyes and Ears



Ammeter needle is a guide to the condition of the battery as well as the state of the car's ignition

YOUNG Henry Canton jabbed his toe viciously at the starter button. A feeble whir was the only response.

"It's no use, Hank," insisted Gus Wilson who was standing with one foot poised on the running board. "Your battery's deader than a door nail. Calm down and we'll take a look."

"But it's brand new," Canton protested as the gray-haired mechanic lifted the seat and unlimbered the bolts that held the battery box cover in place. "Say, if that battery's dead already, I've been gyped. I'll go to that fellow that sold it to me and—"

"Hold your horses," broke in Gus. "No sense getting excited. Let's find out a few things first."

The veteran garage man switched the headlights on and off several times. Then he asked casually, "Who put the battery in for you?"

"I did, of course," Canton replied proudly. "And I tightened the cables tighter than a drum."

Gus merely shrugged his shoulders as he switched the headlights on again. "Maybe so, but take a squint at that, Hank," he said, jerking his horny thumb in the direction of the dashboard as the tiny ammeter needle swung from its off position to the charge side of the dial.

Canton craned his neck.

"It takes a better battery than any I've seen to register 'charge' when the lights are on and you're standing still," Gus added, grinning. "You tightened the cable clamps all right, but you tightened them on the wrong terminals. Don't you know a battery has a plus and a minus?"

Canton scratched his head as a flush mounted to his cheeks. "Gosh, that's right, too," he mumbled sheepishly.

"You just drained all the pep out of your battery," said Gus. "With the battery and generator connected up wrong, they bucked each other every time you ran the car. The battery couldn't store up any current, but a good charging will fix that up."

"How about the generator?" put in Canton. "Was that hurt?"

Flickering lights are an indication that there's a short in the lighting system that must be traced

"May have burned the cut-out points a bit, but I can fix them in a jiffy," Gus told him.

A half hour later Gus had installed a rental battery, and announced that the car was as good as new.

"Well, that's one on me," said Canton. "If I had looked at that ammeter everything would have been O. K."

"Sure, but you could stumble over a gold brick if you didn't know what to look for," Gus reminded him. "Here, I'll show you what I mean."

Gus led the way across the garage driveway to a small pile of old tires.

"What would you say about this?" he asked as he selected one and pointed to a large worn spot on the otherwise solid tread.

"Looks like it was weak to begin with. Probably something wrong with the rubber," Canton guessed.

Gus grinned. "That's just what the owner of the tire claimed. He swore up and down that I knew it was a bum shoe when I sold it.

"But any time you see a tire that's got a single worn spot like that," he went on, "you can blame it on the brake on that particular wheel. Either the drum's out of round or there's something wrong that makes the wheel stop in the same spot every time you jam on the brakes. Naturally the tire's going to wear. As far as stopping goes, it's only using about one-fifteenth of its tread.

When a heavy smoke comes out in clouds look out. A black smoke means too rich a mixture

"And that's not the only clue your tires can give you," Gus continued as they strolled back to Canton's car. "Take the front tires. If the outer edges are rounded and the inner edges are worn so they're jagged or fringed, it's a sign the wheels toe in too much.

"On the other hand, if only one of the tires in front shows this kind of wear, it's not the toe-in but a sprung axle or steering knuckle. Then again, if they both wear but one wears faster than the other, it's probably the camber."

Blue vapor that puffs out of the crankcase breather pipe tells a heap about piston rings

"That reminds me," said Canton when Gus had finished. "A friend of mine has a front tire that looks like it's been through a seige of smallpox. Big pieces are gouged out of the tread all the way around. Does that mean anything besides *(Continued on page 99)*

THREE HEAT Electric Gluepot

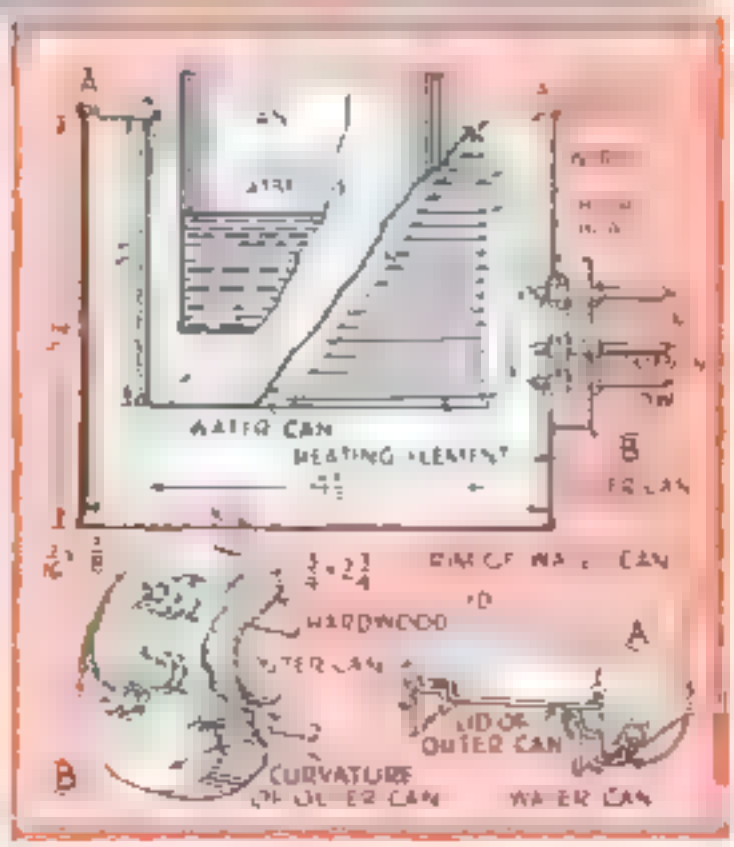
Constructed for Fifty Cents

By SAM BROWN

Three tin cans are needed, and the tops of two of them are cut out on a lathe or drill press by holding a sharpened file against the tin as in the left hand photo. The other views show the method of winding the coil on asbestos and the finished gluepot

DESPITE the homely basis of its construction—three tin cans and two discarded electric-iron heating elements—this electric gluepot rates high in respect to both appearance and performance. It cost only fifty cents for materials

Construction starts with the tin cans. The outer can is the conventional 5-lb. variety approximating the dimensions given. The water can, on which is wound the heating element is a standard 1-lb. can in which floor wax is packed. The glue can may be anything that will fit loosely within the water can. The manner in which the two larger cans are locked together should be apparent from the pictures. Both lids are cut—this can be done easily on the lathe or drill press in the manner shown—and the circular rim cut from the small can



lid grips the projection of the large can lid to make a secure joint. No solder is necessary, nor should any be used

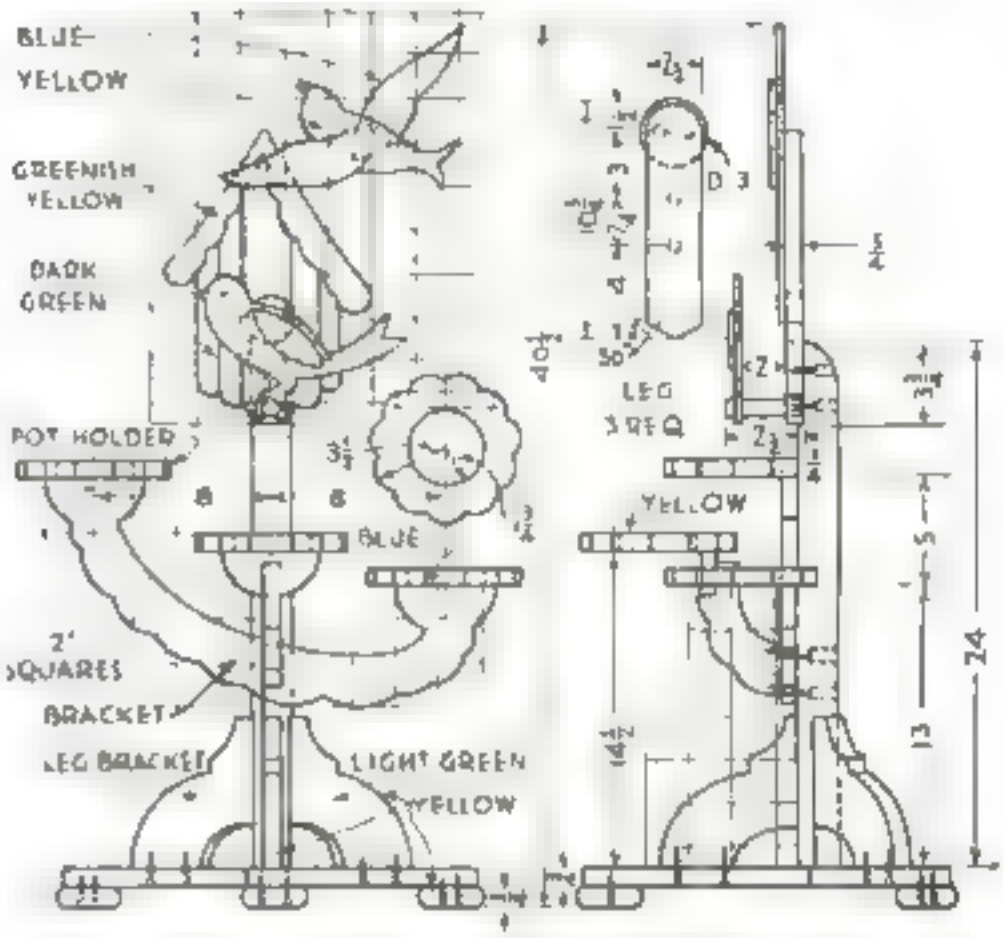
The outside of the water can is first covered with a layer of sheet asbestos. Narrow (1/16-in.) strips of asbestos are then pasted in place, forming a spiral track for the heating element The strips can be easily cut on a paper cutter, if available, and applied in 8-in. lengths to the pasted asbestos covering

Two 500-watt electric-iron heating elements form the element for the gluepot, thereby making the full element "pull" 250 watts. The wire is simply wound around the can inside the channels formed by the asbestos strips. There should be about 20 turns of the diameter given. String can be used to hold the ends of the wire in place while it is being wound. The common terminal lead is taken off at the bottom of the can Use No. 14 wire, bare or with asbestos insulation. About ten turns up, take off the lead for the high heat. Allow four or five more turns and take off the intermediate heat Fasten the low-heat lead to the top of the element Solder cannot be used, and all joints must be securely crimped between split rivets. Notice in the photo of the winding how small sections of asbestos are placed beneath the (continued on page 85)

 BLUEPRINTS for Popular Science Monthly projects are listed on page 80.

Gay-Colored Wooden Birds Decorate This Flowerpot Stand

Finished in colorful enamels, this novel stand provides a bright accent for almost any room. It holds [illegible]



Front and side views of the stand and plan views of the flat legs and the flowerpot holders. To make full-size patterns for the parts, draw 2-in. squares on wrapping paper and copy the outlines from point to point

CUT-OUTS of a bird house and birds ornament this colorful flowerpot stand, which forms a gay and unusual accent for almost any room.

The first step in the process of construction is to make full-sized paper patterns of the bird house and birds, the brackets, and the pot holders. The template for the pot holders is merely a 7-in. circle having eleven equal scallops and a 3½-in. hole for a pot. To obtain the divisions, step around the circumference with dividers. The other patterns are drawn through 2-in. squares as shown in the accompanying drawings and are then transferred to the wood with carbon paper.

Overlays of ⅛-in. plywood on the bird house suggest the projection of a thatched roof. Cut the gable roughly to shape, glue and nail the overlays, and saw the roof line of the house at the same time as the overlay. Slabs of random width are sup-

The up-to-date way of smoothing the sawed edges is with a belt sander on the band saw

posed to form the front of the bird house. These are imitated by scoring vertically with a small gouge. Make four lines

The round central column is 2 in. in diameter, notched at the top for the bird house, and at the bottom for the leg brackets. Counterbore deeply for screws.

The three pot holders, held together with nails driven in the waste wood at the center, can be band-sawed and sanded together, as can the leg brackets. The birds are given a more realistic effect by placing the right wing of the upper bird behind its body, and the left wing of the lower bird over the body.

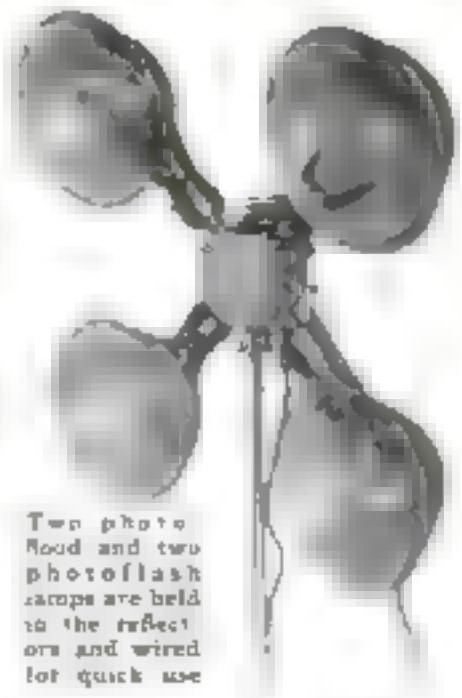
Before assembling the stand, it is a good idea to raise the grain of the wood by sizing each piece with thin glue, and afterwards sand it smooth and coat with thin shellac. Two coats of enamel will then be sufficient to give an excellent finish. The bodies of the birds are yellow, and their wings blue. Blend the colors over the back by painting them blue and stippling with yellow, merging the dots together at the ends.—EDWIN M. LOVE.

MONEY-SAVING HOLDER FOR PHOTO BULBS

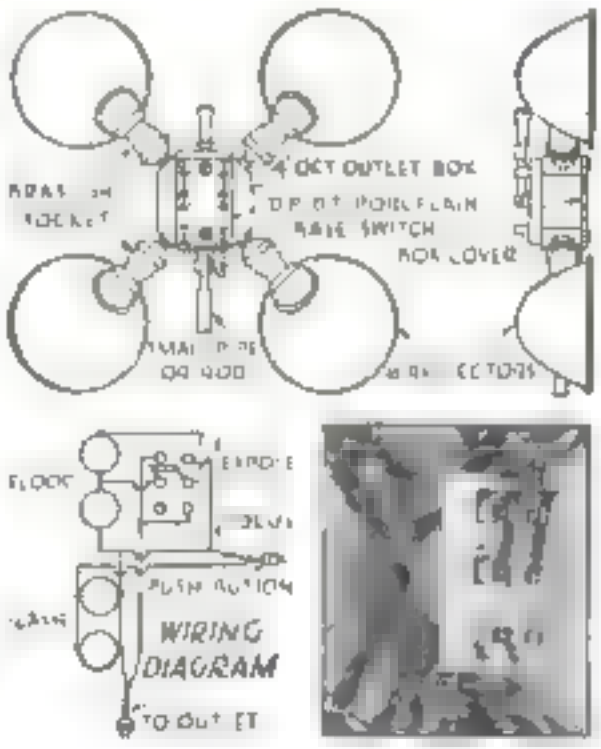
FOR either the amateur or the professional photographer who does considerable work with photoflash and photoflood bulbs, the outfit illustrated is useful and convenient. It consists of four sockets and reflectors radiating from an ordinary octagonal outlet box. Two sockets are for photoflood lights and two for flash bulbs. The flash bulbs are operated by a push button on a flexible cord, while the flood lights are controlled by a double-pole, double-throw switch.

Since the flood lights have a life of only about two hours, the switch is provided so that the two bulbs are operated in series for focusing and composing the picture, thus burning them on half voltage. When exposing the picture, the switch is thrown to the other position, giving full illumination. When taking flashlight pictures, the flood bulbs may be used in series for arranging the picture.

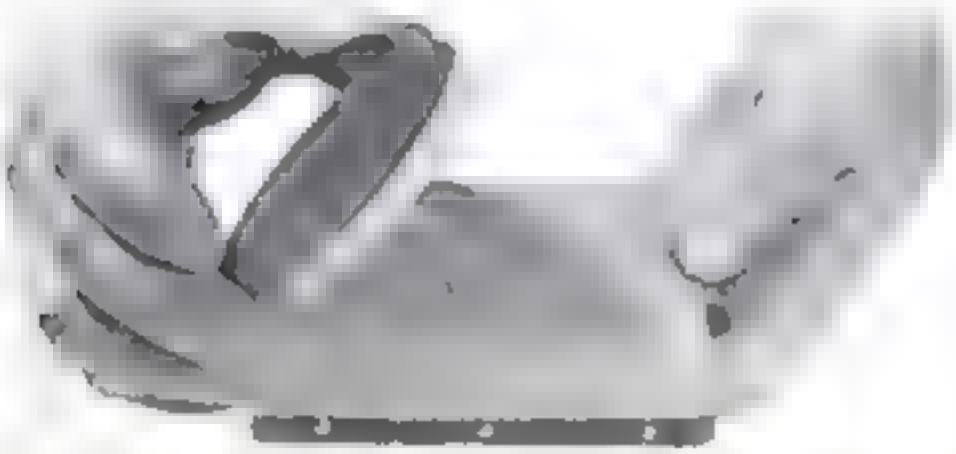
The outlet box may be mounted on an old music stand base or any other convenient base, or a clamp may be attached to it.—LEE M. KLINEFELTER



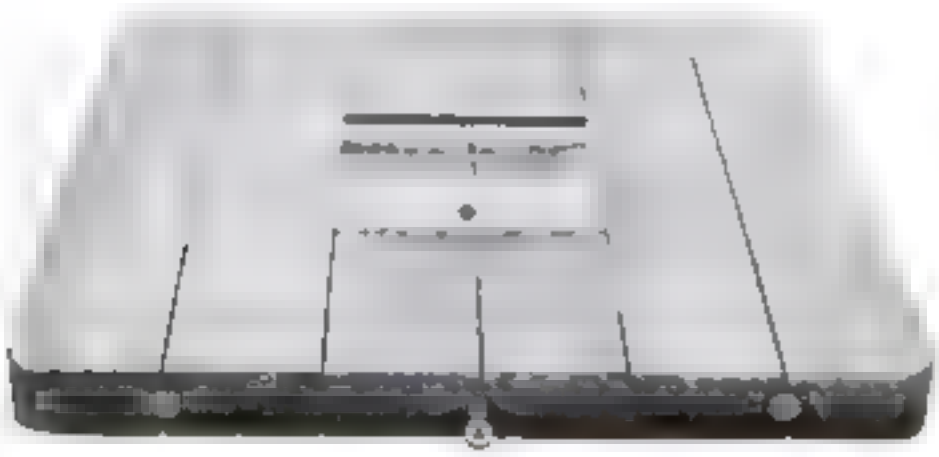
Two photo flood and two photoflash lamps are held to the reflectors and wired for quick use



Trick Board *Makes Dime Vanish*



The dime is placed in the center of the prepared board, a cover is set over it and it is vanished by allowing it to slide into the slot shown below. The locking pin can easily be kept hidden under the thumb



BY GEORGE S. GREENE

WHEN a dime is placed on this trick board and covered with a shallow lid, it vanishes as quick as a wink. The coin can be made to reappear just as mysteriously and the best part of the trick is that the board and cover may be passed for examination with very little chance that the secret will be discovered.

The board is made in three sections of ¾ in. thick pine, each 4 in. long and 1¾ in. wide, with the edges joined so perfectly that it looks like one piece. The centerpiece (part *B* in the drawing in the lower right-hand corner of this page) is divided into three equal parts with pencil lines and carefully cut apart at an angle of 15 deg. as shown. A cut is made at an angle in part B^3 large and deep enough to take a dime easily.

Drill holes ¾ in. deep in the exact center of the inside edges of parts *A* and *C* to take ⅜ in. long points cut from small brads. Assemble the parts as shown, pushing part B^3 (which is a trick panel) against the points as a mark for drilling.

Assembled, the panel B^3 can be depressed at one end so that a dime placed on it will slide into the slot cut in part B^3. Coat all edges except those of the panel with a thin white (No. 2 style) casein glue and allow to dry. Then apply a thick mixture of the glue and clamp the parts together to dry overnight. Sand the board smooth.

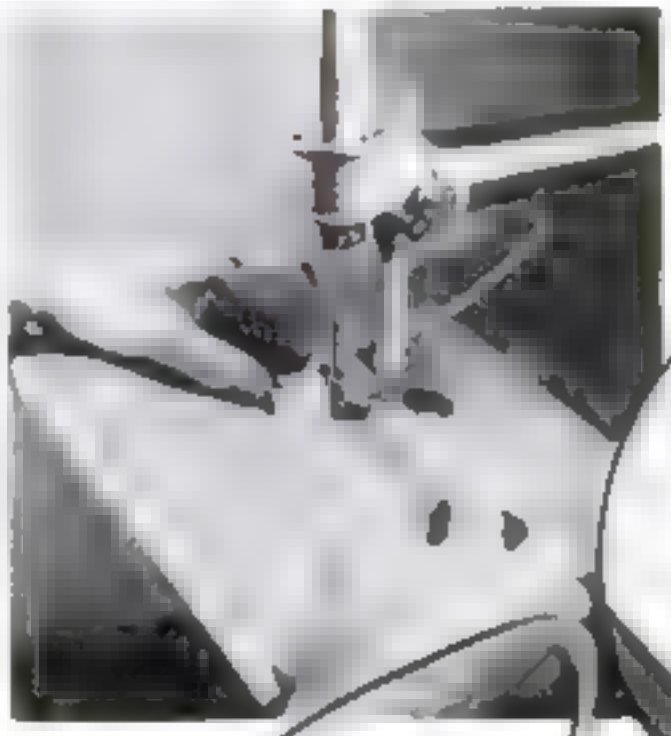
No matter how carefully made, the joints will not be entirely invisible, so conceal them by cutting shallow grooves with a very fine saw in the surface of the board so that it resembles a miniature checkerboard, except that it has only six squares each way. If you acquire a reasonably skillful method of presenting the trick, these lines will be sufficient camouflage. However, it would be easy enough to finish the board to look as if it actually were used for some game and introduce it as part of some preceding trick or "patter," in which case it could be picked up casually for the coin trick without arousing curiosity as to the reason for the checkerboard effect. Finish the board with two coats of shellac.

So that the board may be passed for examination, the panel is made to lock in place. Three short round-headed brass brads or escutcheon pins are driven into each edge, but the one in part B^1 consists of a similar brad head soldered to a length of stiff wire. This fits into a hole drilled through B^1 and down into the panel B^3. The panel can be operated when the lock brad is pulled out about ¼ in.

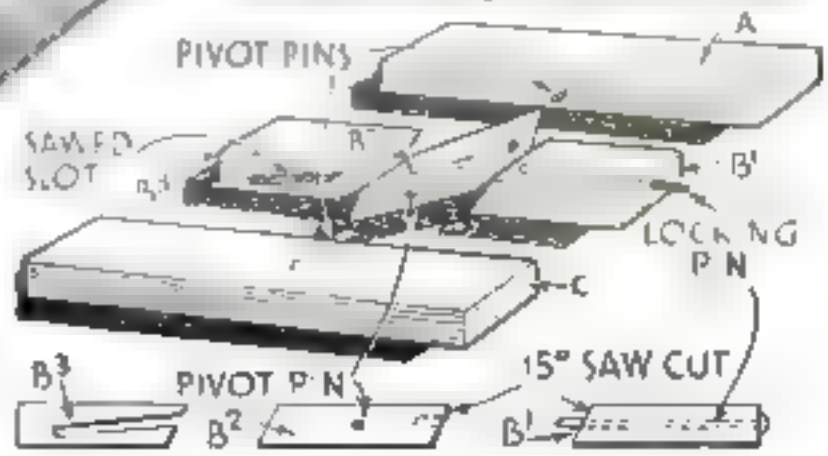
The lid consists of a shallow wood disk with the center cut out and a disk of dark paper glued to one side. A teacup can be used as well.

To show the illusion, pull out the lock brad and cover it with the thumb. Place a dime on the panel, cover it, and immediately tilt the panel from underneath with the fingers, whereupon the coin will slide into the slot. Even up the panel and remove the cover to show the dime gone. It is made to return by reversing this operation and tilting of the board. Then push home the lock brad.

To vary the trick, allow the coin to pass through the board and fall to the floor; or catch it with the fingers and produce it elsewhere.

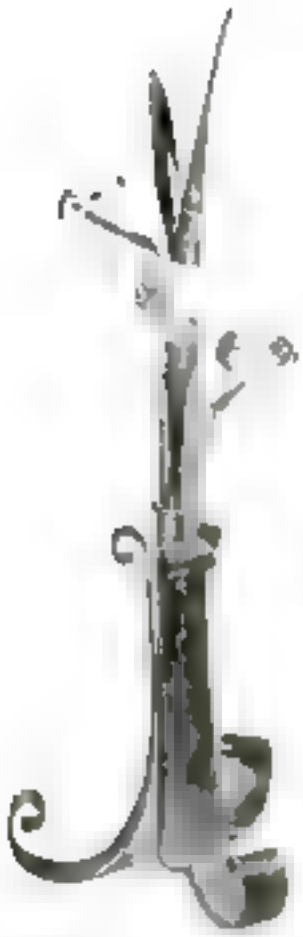


The parts are assembled in such a way that



To conceal all the joints, a series of fine saw cuts are made across both sides of the assembled board. *At right* Drawings to illustrate the exact method of construction

A CLOCK-SPRING VASE HOLDER



This bud vase is a test tube placed in a holder made from an old clock spring. The bent legs are riveted to a ring shaped collar over a steel rod as illustrated above

You can make an attractive bud vase from a glass test tube and an old clock spring. Select a tube about ½ in. in diameter and 5 or 6 in. long, and a spring ⅝ in. or so wide. Heat the spring to redness to remove its temper, and cut into lengths sufficient to make three or four legs. These are curved as shown in the photographs, or in any other manner that is pleasing. Make a collar out of clock spring of a diameter to slide snugly over the tube. Then drill three holes at equally spaced points around its circumference to receive the wire-nail rivets that pass through the legs.

Riveting is easy if you use a steel rod supported at both ends, as shown, to hold the work while hammering the rivet. Slide the test tube into the collar, and your vase is ready to hold flowers. Two ring-shaped collars will give more rigidity, although one serves nicely.—ERVIN WALTERS

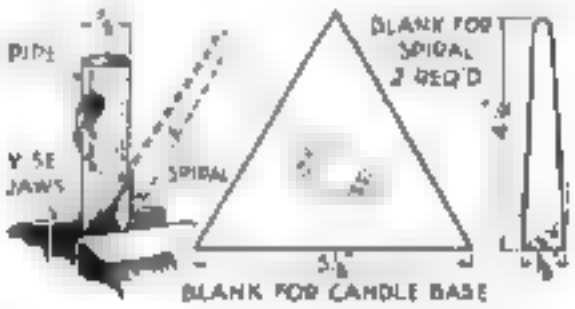
EASY WAY TO MAKE BRASS CANDLESTICKS

Their simplicity and angularity give these candlesticks a distinctly modern appearance

THESE candlesticks have a certain simplicity of design that sets them apart from ordinary commercial products and they can be used in many places where more cumbersome candlesticks would be unsuitable.

With a pair of tin shears, cut out two triangles with sides 5½ in. long from 18-gage sheet brass. These form the bases. Then cut four tapered strips from the same material 4½ in. long and ⅝ in. wide at the base. All are hammered evenly on one side with the flat face of a ball-peen hammer. Get a short length of iron pipe with an outside diameter of ¾ in. and, holding one of the four tapered strips against the side of the pipe, place the two in the vise as shown below and bend the blank around the pipe to form the spiral. Do the same with the other three. Then remove the pipe, place each spiral in the vise, and bend the lower end back at a right angle for attaching to the base. Drill two holes in the base end of each with a No. 14 drill.

Scribe a ¾-in. circle in the center of the triangle base. Set the spirals in place and mark, drill, and rivet the spirals with No. 14 brass escutcheon pins. Buff and polish, or, if an antique finish is desired, heat slightly until the candlesticks take on a brownish color.—DICK HUTCHINSON

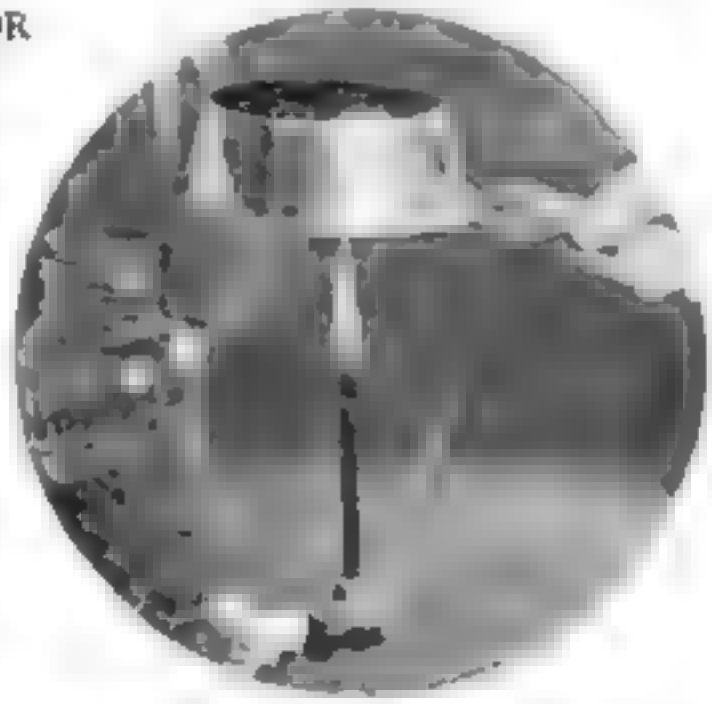


How to lay out blanks for the base and the candle holders and how to bend the spirals

OIL AND HEAT COLOR ALUMINUM BLACK

UNUSUAL decorative effects can be produced in making aircraft articles from aluminum by blackening portions of it. Also, kitchen pots and pans of aluminum will heat somewhat quicker if their bottoms are black rather than bright and highly polished.

One way of obtaining a black finish is to go over the area to be treated with fine sandpaper or powdered emery and water and then apply a thin coat of olive oil. Heat the utensil over a gas flame until the oiled area changes to brown and finally becomes black or almost black. Apply another coat and heat, repeating this until the desired density has been obtained.



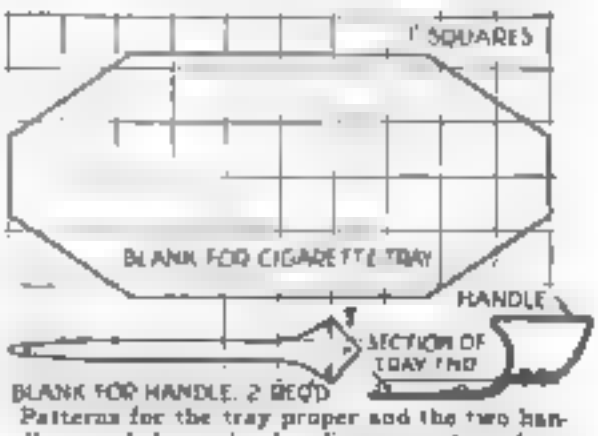
Any articles of aluminum can be colored black wherever desired by applying olive oil and heating

Another substance that will produce similar results is dry shellac, which is applied to the aluminum while it is hot. Shellac, however, seems to adhere less firmly than the carbonized oil. In either case, the aluminum surface should be roughened to prevent flaking.—R. E.

Hammered Copper Tray Designed for Passing Around Cigarettes to Guests

AN attractive cigarette tray can be made from 16-gage soft sheet copper cut as shown at the right. The blank for the tray is held for shaping at about a 45-deg. angle on a smooth metal block. With a ball-peen hammer, begin hammering about ¾ in. in from the edge. Drive each blow toward the edge, working around until it is cupped sufficiently, then place it on the edge of the block and use the flat face of the hammer to make a ¼-in. flange on the sides and a 1-in. flange on the ends. Finally, hammer the bottom out smooth. The handles are then hammered, bent, and attached with No. 14 escutcheon pins.

Wash the tray thoroughly in soap and water, then immerse it until it turns deep brown in a solution made by dissolving a piece of liver of sulphur the size of a hickory nut in a quart of water. Remove, wash and dry, polish, and lacquer.—D. H.



Patterns for the tray proper and the two handles, and how the handles are riveted on

Testing Model Planes with a Simply Built

WIND TUNNEL

The general set-up for testing a model and, at right, photographs of a kite-wing test model and the flying model developed from it

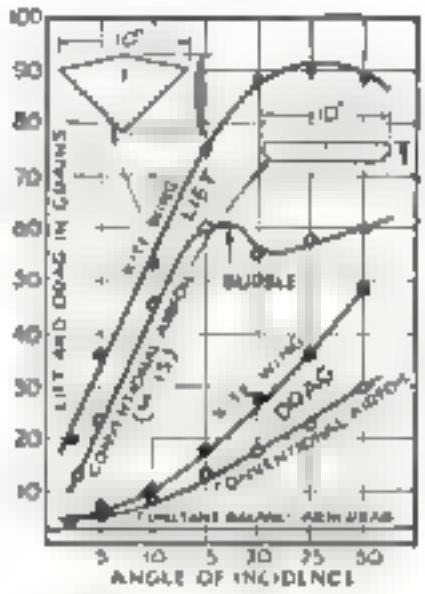
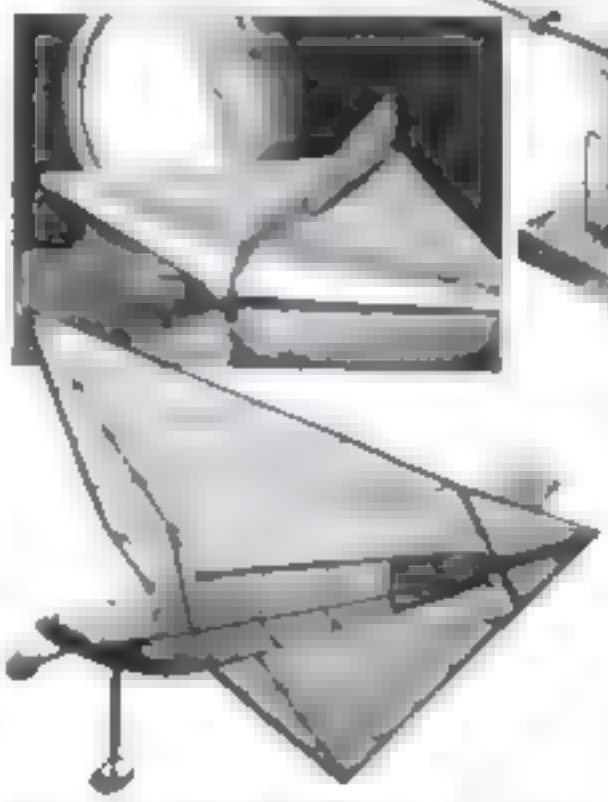


Chart showing comparison of wind tunnel tests of the kite-wing and an ordinary airfoil in respect to the lift and drag at various angles



By Laurence J. Lesh

Aeronautical Engineer and Inventor

AIR-MINDED youths may test their models and learn much about scientific aerodynamics by building a simple wind tunnel. This consists of the four units represented in the accompanying drawings.

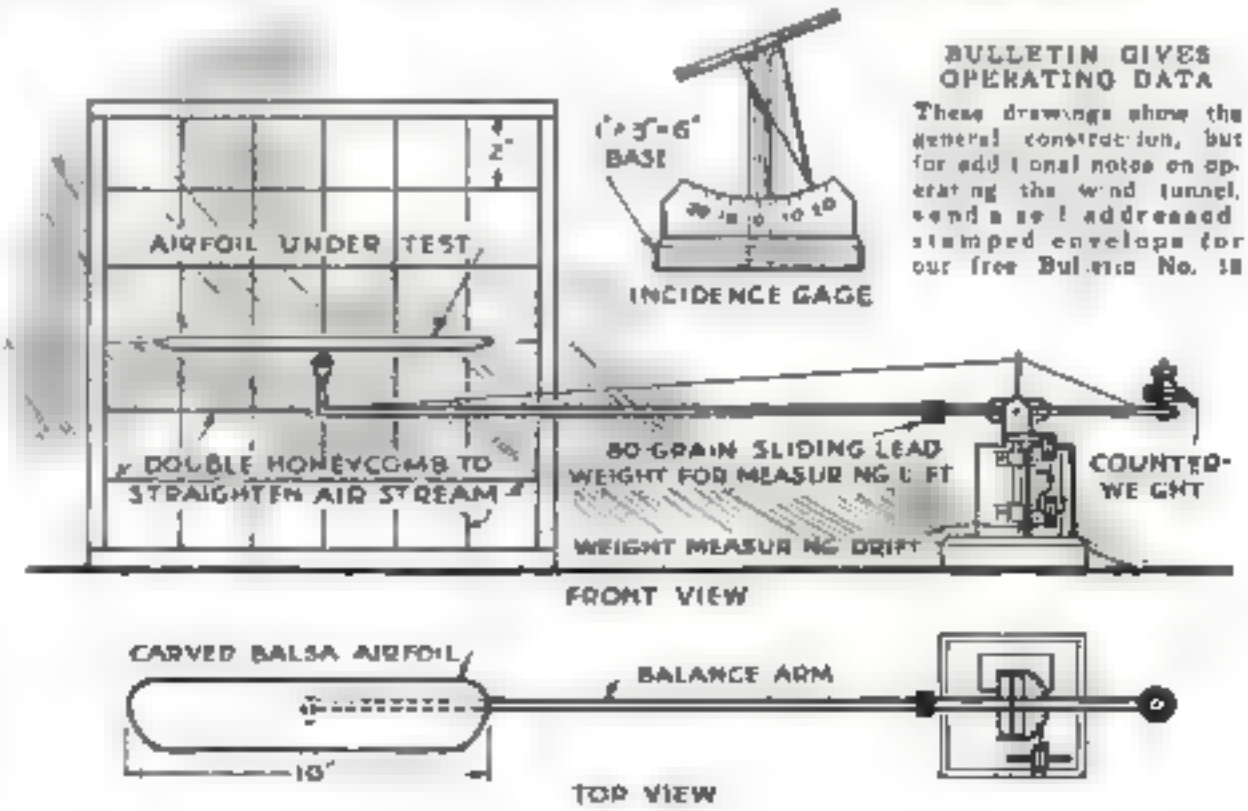
The first unit is an ordinary electric fan, preferably of the quiet-running order. The second unit is a square box open at both ends and having at each opening a honeycomb, or wind straightener, built like a cardboard egg protector of the square variety and 2 in. deep. These honeycombs may be of cardboard, fiber, sheet metal, or thin plywood. Stand this box exactly square with the wind blast, attach some silk threads about 6 in. long at various points over the outlet honeycomb, and determine the extent of the uniform air stream so produced.

The third unit is an aerodynamic balance. An arm about 20 in. long is properly counterweighted to support the model under test in the wind stream. This arm, is made of spruce about 3/16 in. thick and ⅝ in. wide, carefully streamlined to reduce its resistance where exposed to the wind stream. It is pivoted so that the model is free to move up and down and forward and backward. A lead weight of about 80 grains slides along this arm. The length of the arm from the central pivot to the end where it bends up to support the model is carefully measured off in inches.

If the model is placed on the end of the arm and the counterweight, consisting of a number of lead washers, is adjusted so that the arm remains horizontal, it is obvious that placing the 80-grain weight at the end of the arm means that the model will have to lift 80 grains in order to support this weight in the wind stream. Since the arm is divided into 20 parts, moving the weight to the middle of the arm means that the model, if it supports the arm horizontal, would be lifting half as much, or 40 grains. The position of the weight along the arm therefore measures lift as 80 divided by 20, or 4 grains per inch.

Directly under the arm and fastened to the vertical shaft is a segment of a pulley. A light string is attached to this pulley and passes over a small pulley and down at right angles to a hook upon which various weights may be suspended. When the model balances in the wind stream, the value of these weights divided by 20, which is the ratio of the length of the arm to the radius of the pulley segment, is the measure of drift or drag. Mechanically this arm and the bearings must be perfect. I use a pair of 40-cent ball bearings, placed about 4 in. apart for the vertical shaft, and a U-shaped bracket of spring brass to support the horizontal steel pivot.

The fourth unit is an incidence gage to permit adjustment of the test surface or airfoil to the exact angle desired.

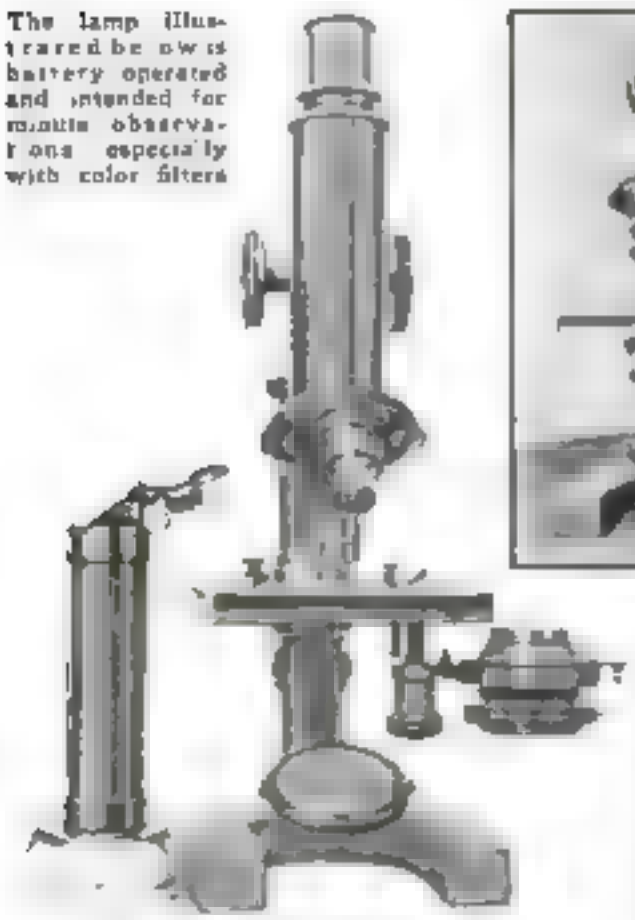


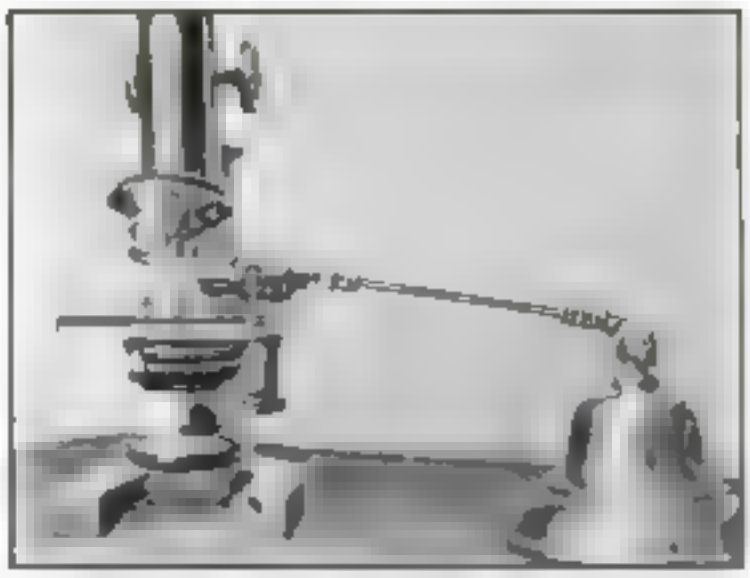
BULLETIN GIVES OPERATING DATA

These drawings show the general construction, but for additional notes on operating the wind tunnel, send a self-addressed stamped envelope for our free Bulletin No. 18

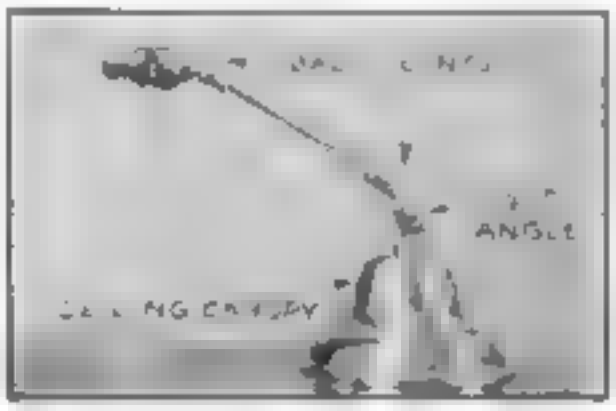
Two Overstage Microscope Lamps Made from Inexpensive Parts

The lamp illustrated below is battery operated and intended for minute observations especially with color filters





The bulb used with this lamp is so small that it will fit between the objectives



At right General utility overstage light assembled from standard parts obtainable at practically any large well-stocked electrical supply store

Two inexpensive methods of making overstage lights for a microscope are shown in the accompanying illustrations. The first compares with professional apparatus in efficiency, yet it can be constructed from parts sold in any electric supply store or at the electrical counter in chain stores.

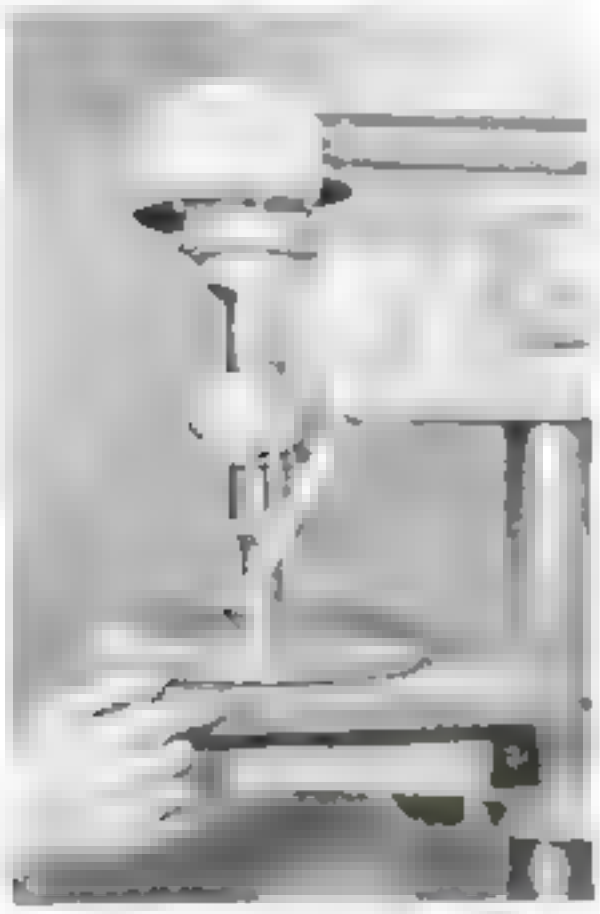
The base is a ceiling canopy costing 10 cents. A block of wood is fastened inside it with plastic cold solder to weigh it down. A 90-deg. angle costing 10 cents is fastened to the base and this carries a 5-cent tube, at each end of which is a 10-cent ball joint. A socket at 35 cents and a lamp costing 20 cents complete the outfit. The top of the lamp may be painted if necessary. It will be noted that this overstage lamp fits between the objectives of the microscope.

The other lamp, which is intended for minute observations, especially when a color filter is used under the subject slide, is battery operated. A pencil type of flash light will furnish the necessary electrical parts. In the set-up illustrated, the subject slide is on top and there is a color filter below it.

Often a combination of overstage and understage lighting will bring out additional details of great value on the subject slide.—Oscar Freeman

DRILL PRESS DRIVES SANDING DISK

Flat wooden surfaces can be smoothed quickly, when a drill press is at hand, by mounting a sanding disk on the spindle. Raise the table as close as possible to the head, leaving, however, about ⅜ in. between the disk and the board to be surfaced. Before starting the machine, feed the disk down till it barely touches the high spots on the work and lock the feed. Start the motor and slide the board around under the rotating disk. After the disk stops cutting, stop the machine, feed down slightly, lock, and repeat.

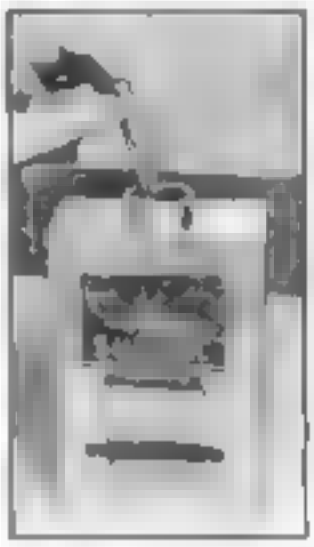


A sanding disk mounted on the spindle of a drill press is used for smoothing flat stock

This method is particularly speedy and desirable for surfacing a glued up table top like that shown in the photograph. The squeezed-out glue along the joints quickly dulls plane edges, but offers little resistance to sandpaper. If both sides are to be dressed, alternate the cutting on each side. In this way it is possible to dress boards to an accurate and uniform thickness.

The surface produced requires no planing; merely remove the circular scratches left by the sanding disk with a hand scraper, and sand with No. 00 sandpaper.

The disk should run at the usual speed—about 3000 R.P.M. for an 8 in. diameter disk. For safety's sake, be sure that the disk is in good mechanical condition and securely fastened on the drill press spindle. If the fastening is made with the usual set screws, it is well to spot shallow holes on the shank for the set screws to bed themselves in. Also be sure to use fresh sandpaper.—Donald A. Price

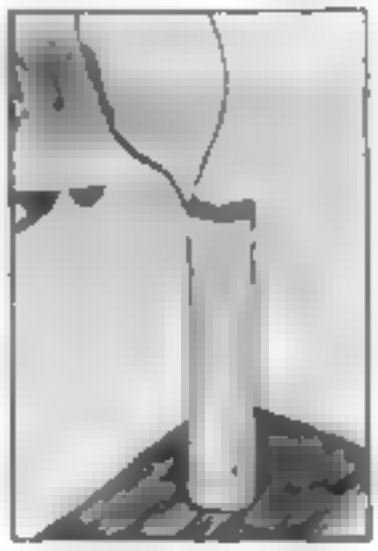


A good grade of sealing wax is dissolved in ordinary white shellac

PREPARING YOUR OWN LACQUERS

Durable substitutes for lacquers of the Chinese variety may be made by dissolving small pieces of sealing wax in white shellac. Any color may be used and one full stick of the wax will be necessary to color about a pint of the shellac. If deeper shades are desired, another half stick will be needed. The sealing wax should be of the best grade—that sold for use on letters and in various arts and crafts.—Cass Sheridon

CASTING INK ROLLS FOR SMALL PRESS



When ink rolls on a card printing press wear out or become damaged, excellent new ones can be made with the old core and a casein glue mixture. If the old core is damaged, a piece of straight doweling will do. The method is also suitable, of course, for making hand rollers.

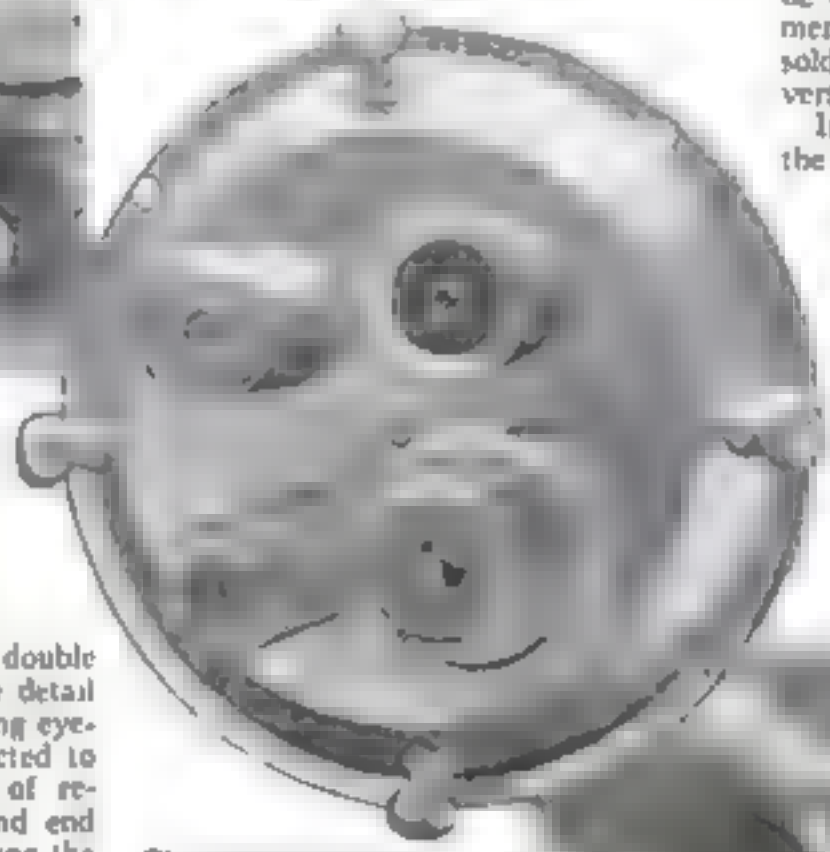
The core is centered in a paper tube of suitable size after the inside of the tube has been waxed. The composition to be poured around it consists of casein glue mixed with water in the usual proportions, to which is added, after it has become creamy, an equal part of glycerine and molasses, mixed half and half.

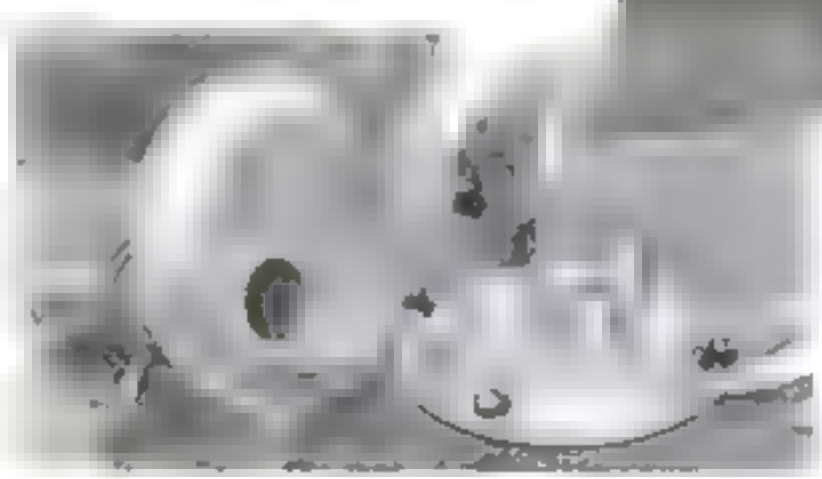
The composition will set in one day, but it should be allowed to cure for a week, during which time it will shrink sufficiently to be removed easily from the form. The roller will be found to give good service as it is very tough and long-lived.—Oliver Bandelier

Eyepiece Turret *for* Amateur Telescope

FORMED FROM PIE PLATES

By L. C. Peltier





The eyepiece turret in use on a reflecting telescope, a close-up of the device with the eyepieces in place, and views showing how it is assembled

EVERY astronomer, whether amateur or professional, knows full well the inconvenience of having to change the eyepieces of the telescope whenever a different magnification is necessary to separate a double star or to reveal more clearly some detail on the moon or planets. A revolving eyepiece turret can easily be constructed to relieve the observer of the task of removing and inserting eyepieces and end the risk of breaking the lenses during the changing process.

Many a lowly pyrex baking dish has been transformed into a telescope mirror, and now a second raid on the kitchenware solves the problem at the other end of the instrument for the chief requirements for making such a turret as shown are two ordinary tin pie plates.

If three or four eyepieces are to be used the plates should have a bottom diameter of about 6 in. Slightly bend the beading of one of the plates so that, when they are nested, the bottoms and sides will be in contact, leaving the edges slightly apart.

Nest the plates and drill a hole for a 3/16-in. stove bolt through both plates in the exact center. Cut another hole in the bottom of the inner plate just large enough to admit the end of the focusing tube of the telescope. This hole, as well as the ones to be cut for the various eyepieces, can be easily made by sharpening a screw driver with a narrow blade to serve as a chisel. First cut around the scribed circle, then smooth up the edges with a round file. Solder this plate directly to the telescope tube, using a try-square or straightedge to make sure that it is mounted accurately at right angles to the line of sight. In most cases it will be found best to pivot the turret directly above the telescope tube, as this prevents any interference with the pier or mounting when the instrument is pointed toward the zenith.

Lay out and cut the holes for the eyepiece tubes in the other plate so that each one when rotated will line up with the large hole in the inner plate. The eyepiece tubes are made by rolling a piece of light-gage sheet metal over a piece of pipe to give it the required form then using the eyepiece itself to get a good, close slip fit. The butt seam is soldered and dressed down with emery paper. The length of these tubes should be determined by the individual requirements of the observer, but each must be soldered to the plate as squarely and vertically as possible.

In order that the observer can tell in the dark just when the various eyepieces are in the proper position for use, a ¼-in. hole should be drilled in the rim of the inner plate diametrically opposite the large hole. Bolt the plates together and, when each eyepiece tube is in the observing position, drill a hole in the outer plate to coincide with the one in the inner plate. Thus, in actual practice, the night sky can be clearly seen through the upper holes when an eyepiece is in position.

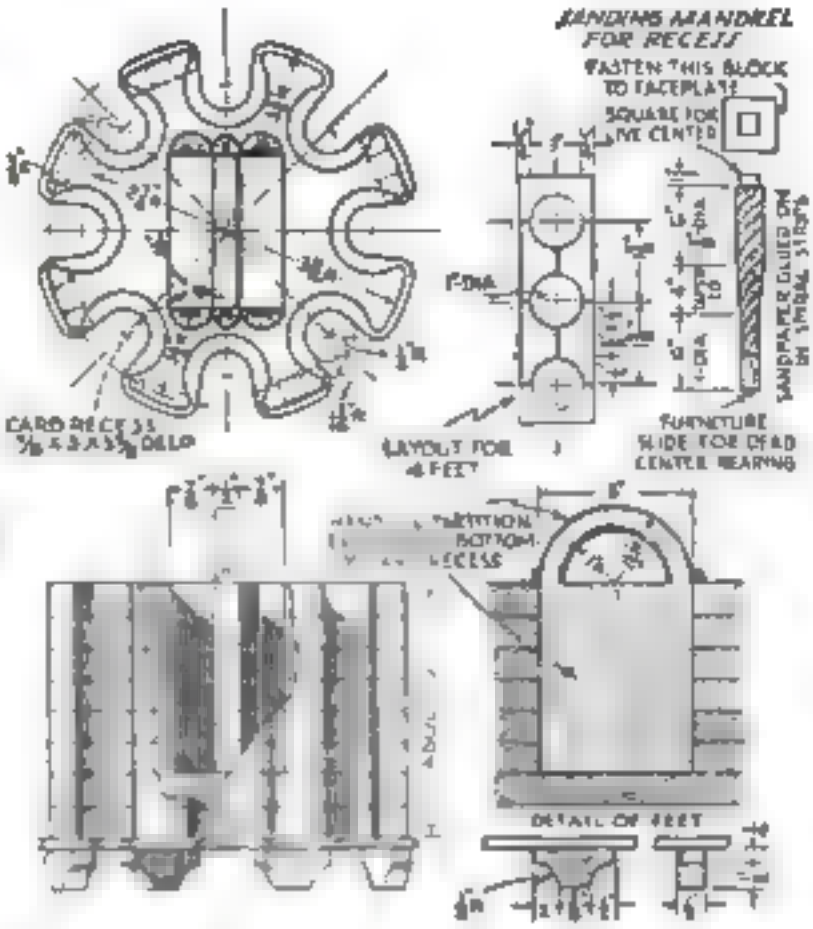
The four knobs by which the turret is rotated are simply pot-cover knobs that have the bolt cut off and soldered to the inside of the large tin washer furnished with them. The washer is then soldered to the side of the plate.

The center bolt should be provided with plain washers and double nuts so that it will not work loose. A thin film of oil or grease should be applied to the surfaces that are in contact. The outside may be finished as desired. Brass or gold bronze give an attractive and professional appearance.

This device is perfectly adaptable to eyepieces of every description as, for example, the large comet-seeker eyepiece shown in the illustration; and, though used here on a refractor, it will function equally well when mounted on a telescope of the reflecting type.

PLAYING CARD AND CHIP HOLDER CUT ON JIG SAW

This neat gamesable accessory won a prize in our recent contest on jig-sawed novelties



To those who are tired of keeping poker chips in a tattered cardboard box, this jig-sawed holder will be a useful and interesting project.

The layout is shown plainly in the drawings, but check the diameter of the chips you are to use. You may select what woods you please, but the original chip holder has a toppiece and handle of poplar, a bottom of three-ply fir veneer, and all the rest is the white, soft wood used in the partitions and ends of orange boxes. The full-size design of the toppiece was pasted directly on the wood and jig-sawed, and this piece was then used as a template to mark all of the pieces except the bottom. Another tracing of the design was pasted on the fir veneer for sawing out the bottom.

Note that the card recess is carried through only enough of the sections to give the required depth for the cards. With the materials I used, the top six sections were cut out, but this made the recess slightly too deep for the cards. This was corrected by gluing a small piece of the fir veneer horizontally across the recess before the handle was put in place.

Unless you are a better jig-sawyer than I am, numerous irregularities will show up when the top six sections are piled on top of each other. However, pile them up anyway and assemble with a liberal supply of casein glue and 1-in. brads driven where they will be out of the way. Assemble from the top down only to the bottom of the card recess, and true up and sand this recess. I used coarse and fine sandpaper glued to a wooden strip to go through the whole assembly. After the card recess is finished smooth, add all the remaining sections except the bottom.

The grooves for the chips were smoothed with a mandrel made as sketched from a section of old curtain pole with the sandpaper glued on in spirals. The old pole I used was so soft it would not hold the live center, so the end was squared and held in a recessed block on the faceplate. For the dead center, I used my pet center for soft work—a highly polished furniture slide or "dome." This metal is very hard, and glassy smooth. File a flat spot in the center of the dome, and drive a round nail set through it. This leaves a smooth hole for the dead center. The small part of the mandrel slips into the outer opening of the chip retaining groove, and the larger part trues up the main recess. If you do not use the lathe, the chip slots can be trued up by hand with this mandrel.

The handle is jig-sawed from a ½-in. piece and sanded round with narrow strips of sand cloth. This handle piece goes clear to the bottom of the card recess and forms a partition.

The four feet are all made from one strip ½ in. thick by jig-sawing the three holes and sawing the strip as shown. The holes might be bored with an expansion bit or a 1-in. auger bit, if one of these is available.

The finish I used was as follows: feet, handle, and card and finger recesses, carmine lacquer, all the rest, black lacquer, except the outside between the slots, where I glued lacewood veneer of the new flexible type which is cemented to a cloth backing for use on walls. This material has many advantages from the standpoint of the amateur craftsman because it does not crack and is so easy to use.

Glue a small piece of felt on the bottom of each foot.—E. J. Creighton

SCROLL-SAW FENCE FOR STRAIGHT CUTS

When a jig saw is the only power-driven tool in a home workshop, it is possible to make it serve in a limited way for straight work such as would ordinarily be done on a circular saw. That is, straight stock for models, small pieces of furniture, and novelties can be ripped to correct widths. The saber blade is used and a ripping guide or fence clamped to the table. For my jig saw, I made a fence from a piece of wood ¾ by 1½ by 8 in. and cut two slots in the bottom end to fit two guide pieces, ¾ by 1 by about 5 in. The latter were fastened securely at right angles to the fence.

In use, the assembled guide is held by means of two C-clamps as shown. Two small blocks are placed between the underside of the table and the lower jaws of the clamps. A guide line is scratched accurately on the surface of the saw table parallel to the sawing line and near the right-hand edge, and a series of pencil marks ½ in. apart are made on the near edges of the two thin guide pieces for aligning the fence.—W. C. Hamilton

The square provides accurate horizontal and vertical edges

STEEL SQUARE IS AID IN SHOP DRAFTING

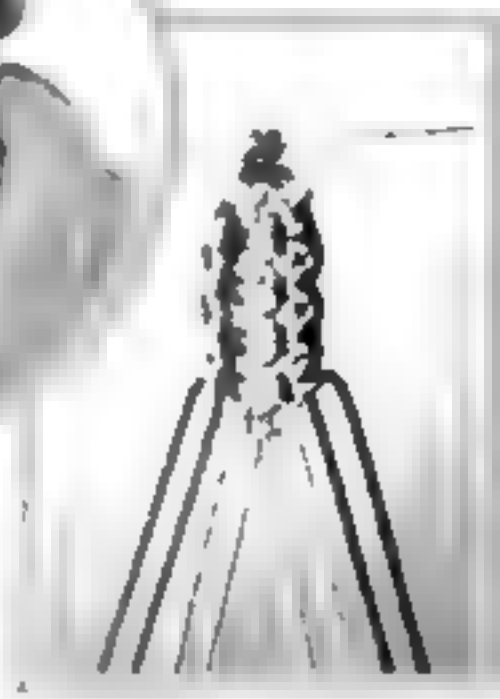
A carpenter's steel square saves time when used as shown for making small drawings and layouts in the shop. Used with or without a drawing board, it takes the place of a T-square. Triangles can be slid along either edge. If necessary, it can be fixed in place on a drawing board by using several long thumb tacks along its outer edges.—Dale Rule.

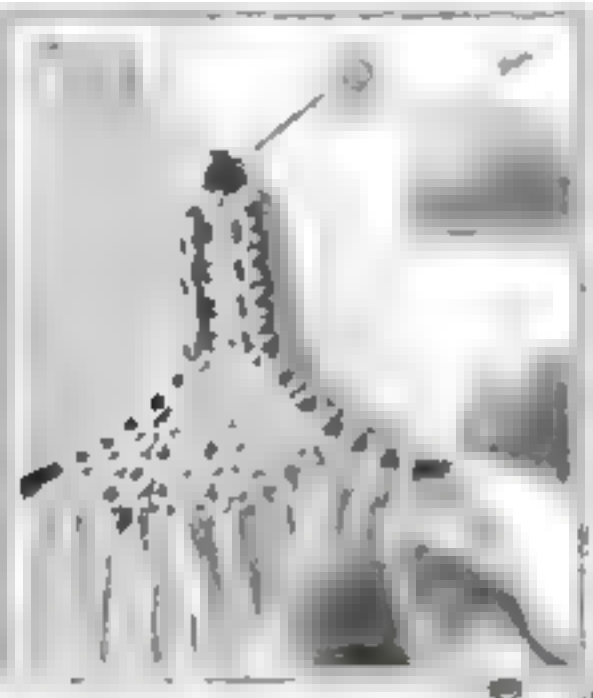
UNIQUE SQUARE-KNOTTED

Cigarette Case

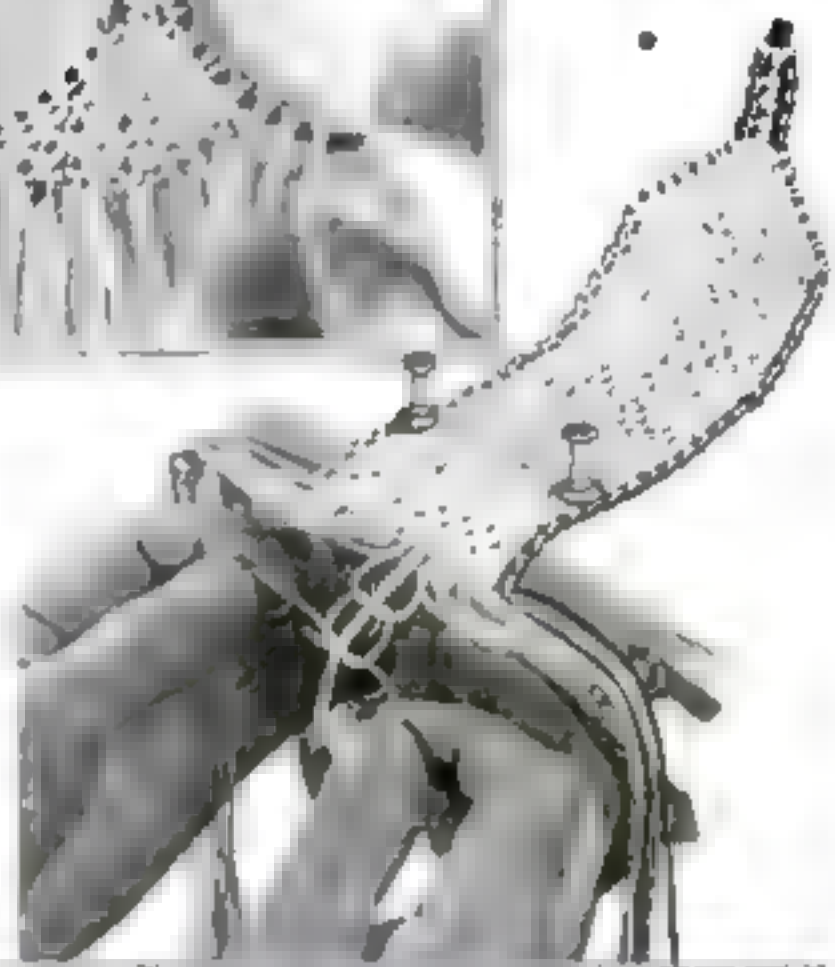
MADE FROM CORD

By Kenneth Murray





In offering a cigarette, the pack may be projected slightly from the case with thumb and forefinger. *At right:* How the tongue is started on a cord anchored at each side and how the new white cords are added



AN ATTRACTIVE case to hold an entire pack of cigarettes can be made with what is known as "polished" or waxed cord tied into ordinary square knots such as sailors use. The knotting is similar to that used in making a man's belt (P S M., Nov. '32, p. 77), and a number of designs in different colors can be worked out by using a little ingenuity.

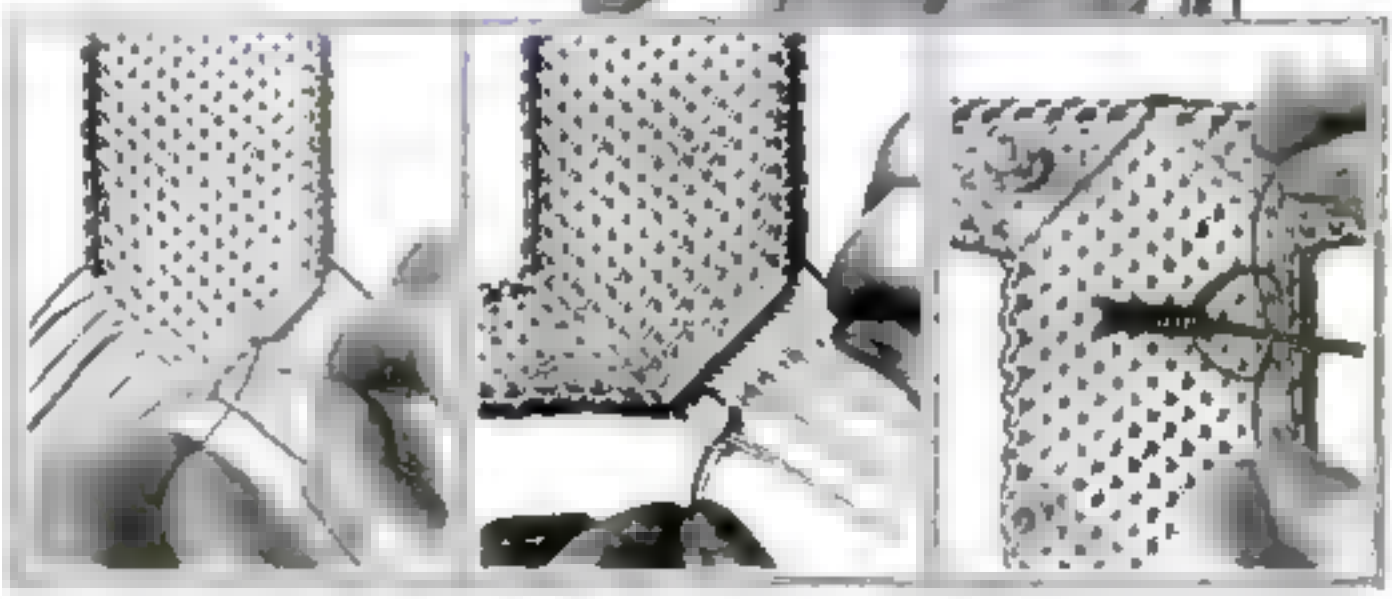
To follow the simple design illustrated, the cords should be cut 8 ft. long, two of black and sixteen of white. Double the two black cords and hang them over a cord securely anchored at either end, then tie them into a single square knot. Divide the black into two parts and add a doubled strand of white to each, up close to the first knot, as shown in the center view above. Using the eight strands, make five rows of square knots to complete a tongue-shaped piece.

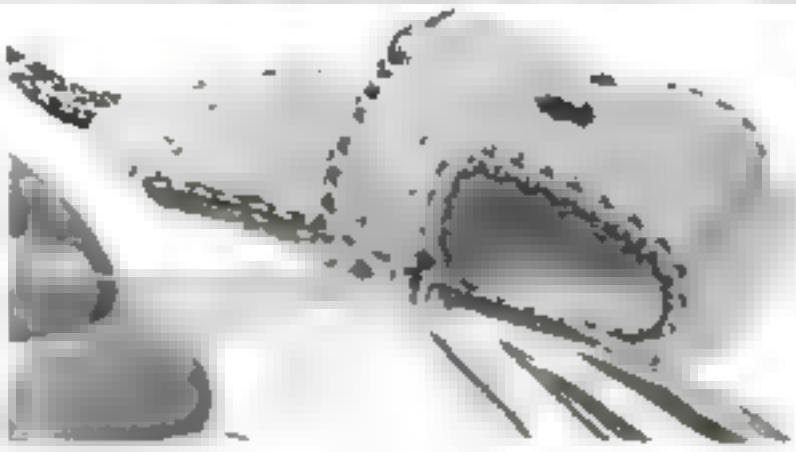
It is now necessary to widen the tongue into a flap by adding seven doubled white strands to each of the pairs of black cord, which remain on the outside. As each pair of white cords is added, a row of knots is made across the piece as shown in the right-hand photograph of the top row. Knotting is continued for 9½ in. from the end of the tongue. The strip thus made is easily handled by fastening it to the edge of a table with pushpins. Bring the work to a point by dropping two strands on either side in each row and adding single rows of half-hitches over a single black strand from the outside as shown in the left-hand photograph in the series of three views just below the center of this page.

This separates the cords into two parts. Now start knotting with each half at right angles to the main piece, and continue for a distance of 1¾ in.

The hold-down for the tongue is placed 1¾ in. down from the point formed by the half-hitches and is in the middle of the piece. Double two 24-in. black cords and slip them through from the back so as to loop about a single square knot, then make continuous square knots over two of the strands with the other two for a dis-

(Continued on page 84)





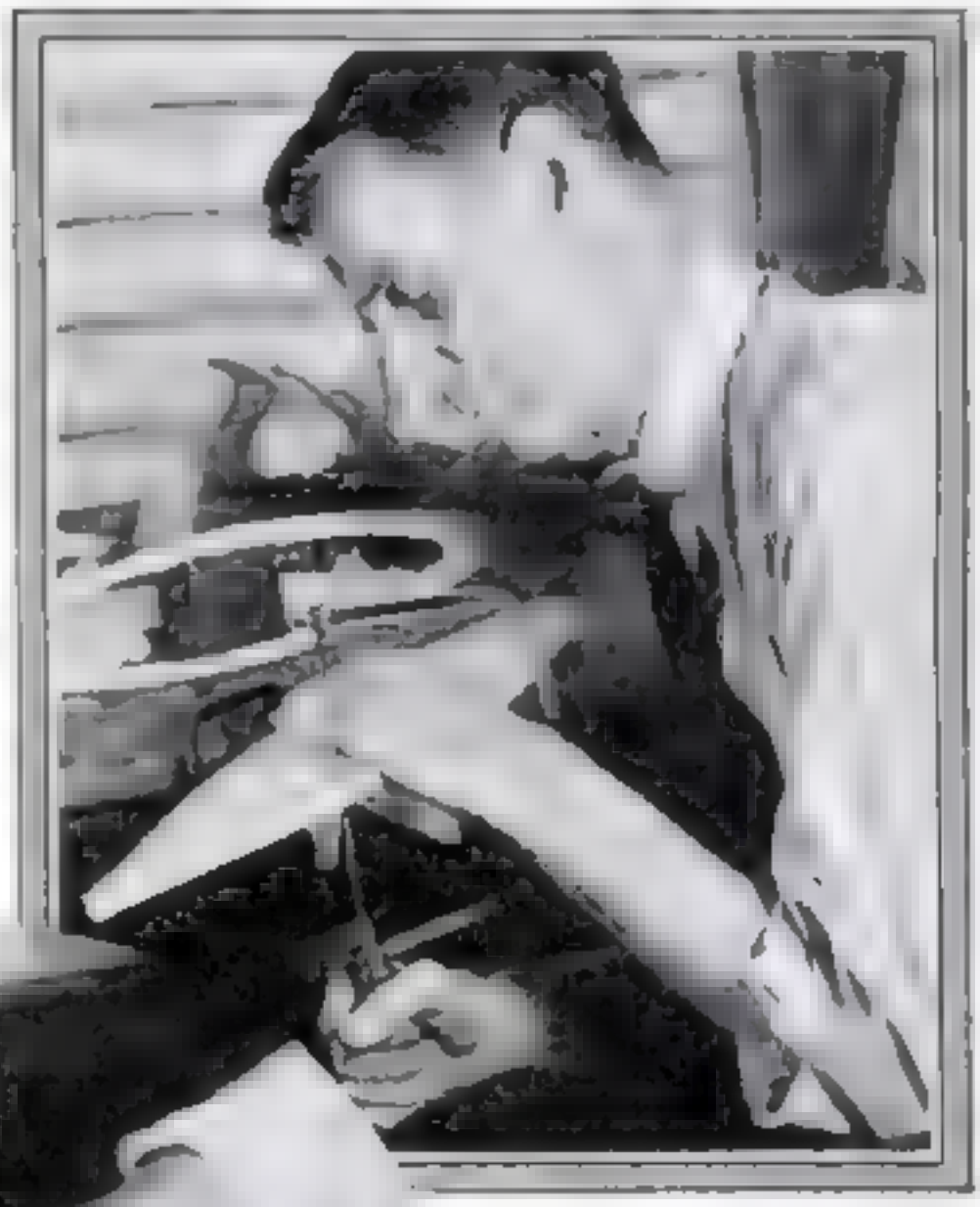
Hold the work with pushpins, and if your fingers are inclined to get sore, cover them where necessary with adhesive tape. The series of three views show how the end is brought to a point with half-hitches, how strips are knotted at right angles to the main piece, and how the hold-down strip is added so the tongue can be slipped under it when the case is closed

At left: Tying the case together while turned inside out

HOW I BUILD Ship Model Hulls

By Capt. E. Armitage McCann

Designer of many Popular S[illegible] Monthly models and founder the Ship Model Makers' [illegible]



SUPPOSE you are ready [illegible] ship model and have a set of POPULAR SCIENCE MONTHLY blueprints o[illegible] first task is to make th[illegible] cedure I have worked out and illu[illegible] ing photographs, you will find it mu[illegible] be likely to expect from studying the [illegible] always look more or less compl[illegible]

In most cases the drawings [illegible] in layers. This is the so-call[illegible] ine or "lift" method of cons[illegible] gest you do

Measure the depth of the lifts and buy wood of th[illegible] thickness, getting sufficient [illegible] If wood of corr[illegible] thickness is unobtainable take a [illegible] planed down, or do it yourself. Wh[illegible] end, however, if you can dr[illegible] suit the thickness of the wo[illegible] is necessary to mark those thicknesses on the body plan and from that plan make new half-breadth lines by marking the widths from the body plan on a new set of construction lines. These construction lines, of course must coincide with the vertical lines on the original sheer plan. Be careful that the deck does not cut entirely through a lift.

In either case take a piece of tracing paper and from the half-breadth plan mark the center line, all the cross-construction lines, and one half-breadth line (the line in which one of the lifts is to be cut). Turn the paper over and, with center and construction lines coinciding mark the other half. Put this on the wood and transfer the outline and the construction lines by means of [illegible] Do this for all the lifts, using [illegible] of construction lines through[illegible]

Cut each piece to within a [illegible] of the outline. Next, it is be[illegible] out all but the top and bott[illegible] marking on the bottom of [illegible] of the lift below and cutting [illegible] say, ¼ or ⅜ in. of that, leaving an extra allowance of solid wood at the ends. Carry a few of the cross-construction lines and the center lines over the edges to serve as guides in later operations.

My method of building up the parts of the hull is to start at the bottom and glue on the next lift, lightly tacking it in position, inside. Be careful that the nails will not reach the outside when the hull is shaved down. When all the lifts have been built up in this way as quickly as possible consistent with accuracy, put the whole in hand screws, clamps, or under weights for at least twelve hours. The nails are chiefly to keep the parts from slipping until the glue sets.

For the final shaping of the hull, make a set of templates from the lines of the body plan. Cut these from cardboard, tin, or thin plywood. Mark on each where the joint of two lifts will come, so that when holding the template to the hull this mark will always be at the right height. The templates must be held at a right angle to the keel. The bottom edge should coincide with the center line of

on the Bread-*and*-Butter Plan

There are many ways for holding a hull to be shaped, but Captain McCann prefers [illegible] octagonal [illegible] at each end. These [illegible] two vises

The water line is not marked until after the [illegible] have been applied to the hull. The hull is then set up perfectly level and a block of [illegible] necessary thickness, with a pen[illegible] is [illegible] saw the [illegible]

Making and attaching the [illegible] is an easy [illegible] work. You merely have to follow the plans and use your own judgment whether to cut them from solid blocks of wood or build them up from thin stock. Much depends upon how carefully they are painted

the hull. Also mark the deck line at the edge of the templates. Do this with great care.

If the hull slopes considerably from the water line to the deck line—this slope is called the "tumble home"—cut the templates vertically upward in a straight line from the widest part. Then, neglecting the tumble home for the present, shave to that shape.

There are several ways of holding the hull while one shapes it. The best method requires two machinist's bench vises of the type which clamp to the bench. These grip the octagonal ends of a supporting stick, which is screwed to the upper lift at points where the holes will not show. Some model makers merely screw on a block of wood and hold that in a vise. I find, however, that if one has a wood bench vise, one can hold the hull in it, either bottom up or side up, while one shaves from the middle to one or the other end. If no vise is available, prepare four V-shaped pieces of wood so as to fit the hull loosely and nail them to a board. Hold the hull down with a cord. The final shaping then can be done with the hull held between one's knees.

When the sides are so far shaped, use dividers set from the edge of the top lift to mark the deck level on the sides, and shave the deck down to within about ⅛ in. of that. Then shave down from the fore-and-aft center line of the deck to the edge so that the deck will have a slight, even crown. On this re-mark the center line and the deck edges. Test out for a smooth curve fore-and-aft with a flexible straightedge. Such a straightedge is a useful thing to use all over the hull, when shaving, to insure that there are no longitudinal bumps or hollows.

Now, and not before, is the time to shave down from the widest part of the hull to the deck line for the tumble home, if any.

Under the stern and under the flare of the bows are the tricky parts. Here is where one needs a half-round rasp, radius spokeshave, or flat gouge. The rasp is the best because it is indifferent to hard or soft grain. The forecastle head and the poop pieces should be glued on before the hull is finally shaped.

The stem, sternpost, and keel are either set in rabbets in the hull or merely glued and nailed on. Try out the stem with cardboard before cutting, and see that the sides come sharply and neatly to it and to the sternpost.

At this point it is wise to make either the permanent base or a temporary support to hold the hull perfectly upright and horizontal, with bits of cloth glued inside the uprights to prevent marring the hull.

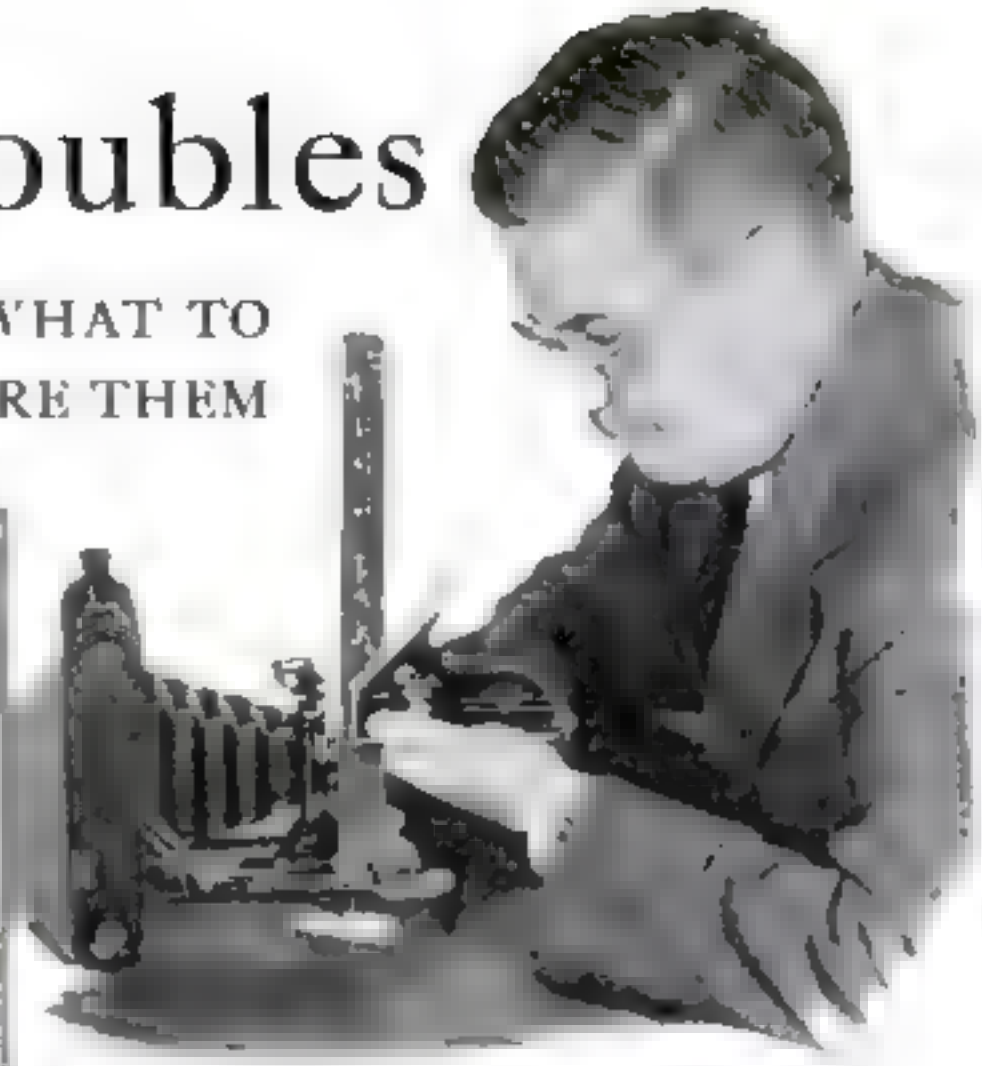
Models with long beakheads and high poops, such as our Spanish galleon and the *Revenge*, are often made with a plywood centerboard and two solid sides, which are sawed and carved to shape, then glued on. This is a simple plan for models which do not have to be extremely accurate.

It is merely a matter of sawing the centerboard to the outline given and cutting out the two sidepieces of the hull from either solid or built-up blocks.

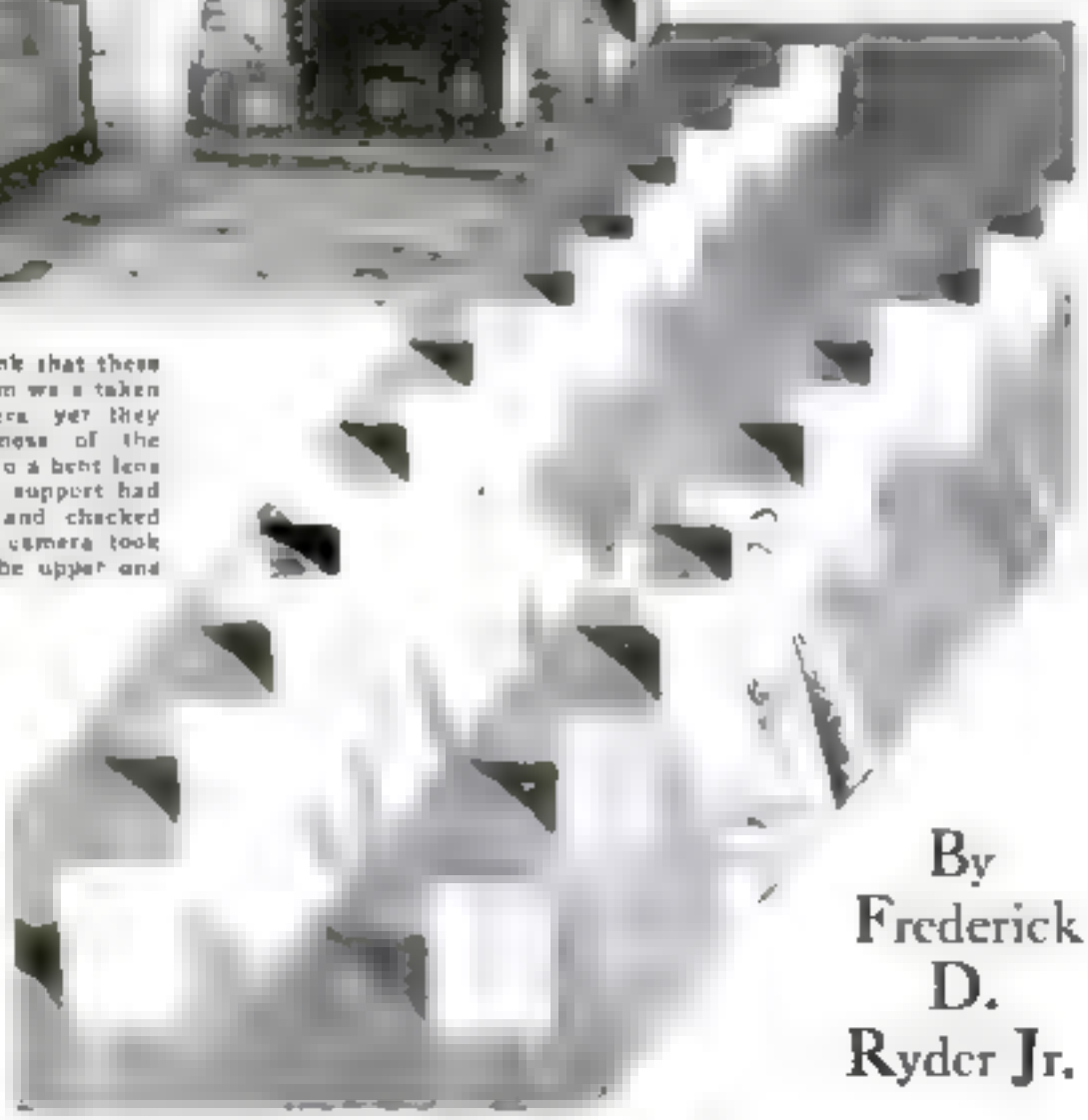
I find the best way to shape these sidepieces is to start with rectangular blocks. Mark on them the construction lines all the way around; then mark the greatest beam line on the top and cut down to this. On the vertical side, mark *(Continued on page 85)*

Camera Troubles

WHY THEY HAPPEN . . . WHAT TO LOOK FOR . . . HOW TO CURE THEM



You would not think that these two views of a room were taken by the same camera, yet they were. The fuzziness of the lower view is due to a bent lens support. After the support had been straightened and checked with a scale, the camera took photographs like the upper one



Focusing scales can be tested by setting up a series of numbered squares as at the right and photographing them. The scale is set to focus on card 0. If this is sharp, the scale is correct but if some other number is sharper the scale requires to be readjusted

BLAMING the camera for the poor results obtained is as common in amateur photography as are similar alibis in other sports and hobbies. In most cases the amateur himself is at fault if his pictures turn out poorly

However, the camera can be the unsuspected cause of unsatisfactory photography. A dirty lens, for example, cannot produce as clear, sparkling pictures as it should, yet large numbers of amateur photographers never give a thought to the condition of their lenses.

A few specks of dust on the surface of the glass have no effect on the definition or clearness of the pictures. What causes trouble is a more or less uniform layer of dust or scum. The remedy is to clean the lens at regular intervals. The surface should first be dusted with a clean camel's-hair brush to remove any particles of grit. Then it should be wiped with an old but clean linen handkerchief that has been through the wash many times. Use a gentle circular motion. The special lens-cleaning tissue sold by photographic supply houses also is excellent

Remember that some of the special types of glass from which camera lenses are made are softer and more easily scratched than ordinary window glass. That is why scrubbing a lens with any old, more or less clean piece of cloth that happens to be handy is quite likely to cover its surface with fine scratches and so permanently injure it

Another camera trouble that may lead you to suspect the lens is dirty is a small leak in the bellows. The fogging of the film by leakage of unwanted light, if slight, will cause the picture to look flat and lifeless much as does a very dirty lens. On the other hand, the pinhole in the bellows may, if it happens to be in the right position, cause black streaks or dark areas in only one particular part of the film.

One of the simplest ways to find a light leak in a camera bellows is shown on page 86. Insert a small electric light bulb in the bellows from the (Continued on page 80)

By Frederick D. Ryder Jr.

PANATOMIC FILM Gives Tiny Camera Big Picture-Making Powers

KODAK PUPILLE, with a lens thirty times as fast as those on ordinary cameras, is the master of almost every situation under which pictures can be made. Some features of this marvelous little camera are described below.

THE miniature type of Kodak has gained greatly in importance through the introduction of Kodak Panatomic Film, a film of such fine grain that tiny negatives produce enlargements of striking size.

The miniature camera, in fact, now has picture-making abilities which are hard to match.

FIRST, it can use an ultra-fast lens, which enables it to get pictures with the minimum amount of light, and at the fastest shutter speeds.

SECOND, the optical law which gives its short-focus lens extreme depth of field enables it to make pictures which are exceptionally sharp.

THIRD, it can make very close close-ups, and work in the most confined spaces.

FOURTH, it is inexpensive to use in the way that insures the best pictures, which is to make a number of shots of each subject.

And now these unique advantages of the miniature camera are not offset by loss of picture quality through enlargement. The new fine-grain Kodak Panatomic Film has, in fact, made super-cameras of the little Kodaks shown on this page.

PANATOMIC—A New Fine-Grain, Panchromatic Film for Small Cameras

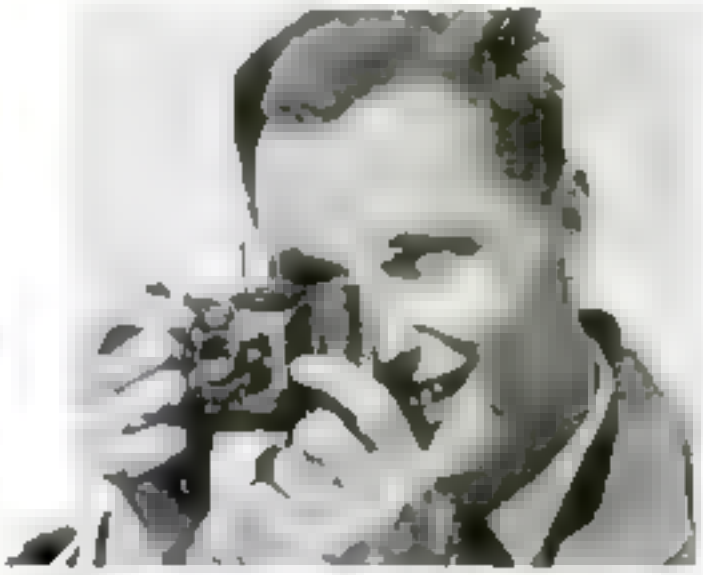
Panatomic pictures of "half-vest-pocket" size can be stepped up to the largest exhibition print size without noticeable granular effect at normal viewing distances. In ordinary picture sizes, enlargements from Panatomic Film are practically indistinguishable in quality from contact prints.

This new Eastman film is not only exceedingly fine-grained—it is also fully color sensitive, offering miniature camera owners the full range of tone effects obtainable only with panchromatic film and color filters.

Kodak Panatomic is as fast as Kodak N. C. Film in daylight and twice as fast in artificial light. It comes in F127 (Vest Pocket), F117 (2¼ x 2¼), and 35 mm. daylight loading rolls. Try it today.

If it isn't an Eastman, it isn't a Kodak

AN ARISTOCRAT among miniature cameras, Kodak Pupille is equipped with an ultra-fast f/2 anastigmat lens and Compur shutter with speeds of 1 to 1/300 second, carried on a precision spiral mount. Has eye-level finder and built-in depth-of-focus scale. Focuses from 1½ feet to infinity. Makes 16 pictures, 1 5/16 x 1 5/16, on vest-pocket size Kodak Panatomic Film, capable of great enlargement. With range finder, 2 filters, and leather carrying case, $75.



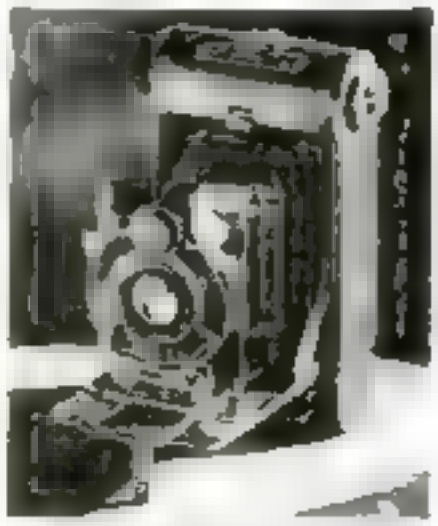
IN THE FRONT RANK of miniature cameras are the two Kodak Vollendas. Shown above is the f/4.5 model. Its fast lens and eye-level finder make action shots easy. Has 3-speed Pronto shutter and built-in self timer. Makes 16 negatives (1 5/16 x 1 5/16), capable of great enlargement on one roll of F127 Panatomic Film. Price, $19.50.

f.3.5 VOLLENDA

at the left has almost twice the speed of the f/4.5 model. An eight-speed Compur shutter gives full play to its fine f/3.5 lens. Accurate focusing and framing is simplified by the depth-of-focus scale and eye-level finder. Makes 16 exposures (1 5/16 x 1 5/16 inches) on a vest-pocket size roll of Panatomic Film. Price, $27.50.

VEST POCKET KODAKS

Small cameras of great picture-making scope, with lenses and shutters to fit your needs. Vest Pocket Kodaks are available with a wide range of equipment from the Model B to the f/4.5 Special (shown at right). May be used with the new fine-grain Kodak Panatomic Film—the small negatives (1¾ x 2¼ inches) make brilliant prints and excellent enlargements. Supplied in five models. Prices from $5 to $15. Let your Kodak dealer show you these fine photographic instruments.



f.4.5 V. P. Kodak Special, $25
Other models as low as $5

P.S. 10-33

FREE INFORMATION ON MINIATURE PHOTOGRAPHY

Clip and Mail This Coupon Today

Eastman Kodak Company, Rochester, N. Y.

Gentlemen: Please send me details of the miniature Kodaks with their exceedingly fast lenses and other unique features—and their use with the new fine-grained, all color-sensitive Kodak Panatomic Film.

Street

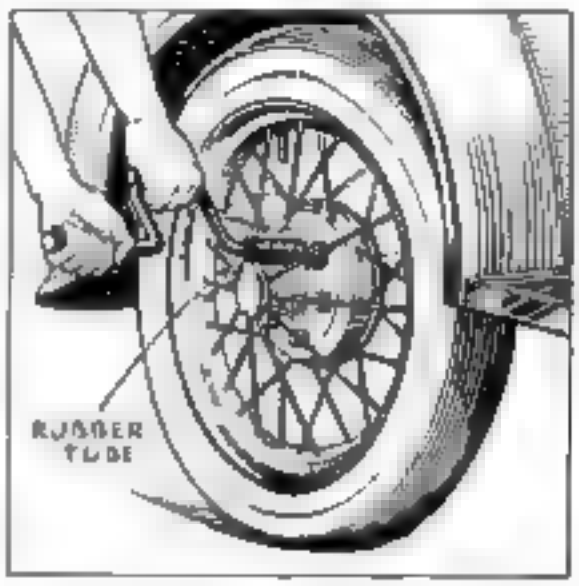
City State

Useful Kinks *for* Your Car

Suggestions Valuable to All Drivers Contributed by Our Ingenious Readers

Bottle fitted with two short lengths of glass tubing, one connected to rubber hose, used to draw gas from tank

SOME arrangement for syphoning fuel from the gas tank is, without doubt, an important part of a car's repair kit. If you carry a short length of rubber tubing for this purpose you can eliminate any possibility of sucking the gas up into your mouth by adding the simple arrangement shown. Select a medium-sized bottle with a large mouth, and fit it with a rubber stopper containing two short lengths of glass tubing. To one tube, connect the length of rubber hose. The second tube is the suction outlet. To use the safety syphon, place the end of the rubber tube in the gas tank and suck momentarily on the other tube. The gas will flow into the bottle without the slightest possibility of entering your mouth and once started, it will continue to flow when bottle is lowered. For larger quantities, tip the syphon bottle and allow the gas to flow into a larger container.—W. E. W.

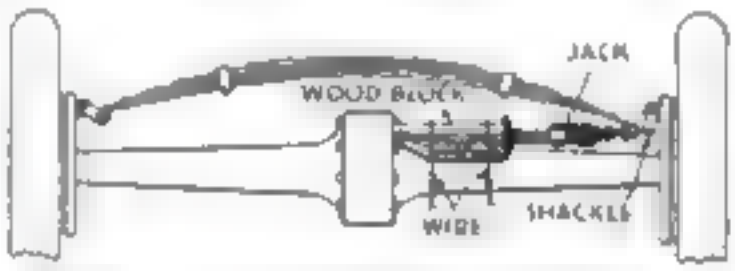


Protecting Wire Spokes

ON CARS equipped with wire wheels it is difficult to use the wheel wrench without scratching and marking the enamel on the spokes and hub, thereby not only disfiguring them but also opening the way to rust and permanent injury. To safeguard against this, you can pad your wrench with a short section of rubber garden hose cut spirally to fit on the first bend as shown in the illustration above. As a result, if the wrench slips, while in use, the rubber strikes the spokes and no damage is done. Although this kink is particularly suited for protecting the spokes on cars where the fastening bolts are located in back of the spokes, it is equally valuable in cases where the bolts are located inside a large sized hub. The rubber hose pad can be removed from the wrench when not in use.—E. J. N.

Tire Jack Resets Spring Shackles

WHEN repairing the rear spring or rear end of a Ford car, you may find it difficult to replace the spring shackles. By using your tire jack in the manner shown, however, you can do the job easily and quickly. First fasten the left-hand shackle in place on the spring. Then using wire or strong, small-diameter rope, secure a wood block to the upper side of the rear axle butting its end against the side of the differential housing and place your jack against the outer end of the block so that its head bears against the eye of the spring. Operating the jack will spread the spring into position and allow you to fasten the right-hand shackle.—E. E. S.



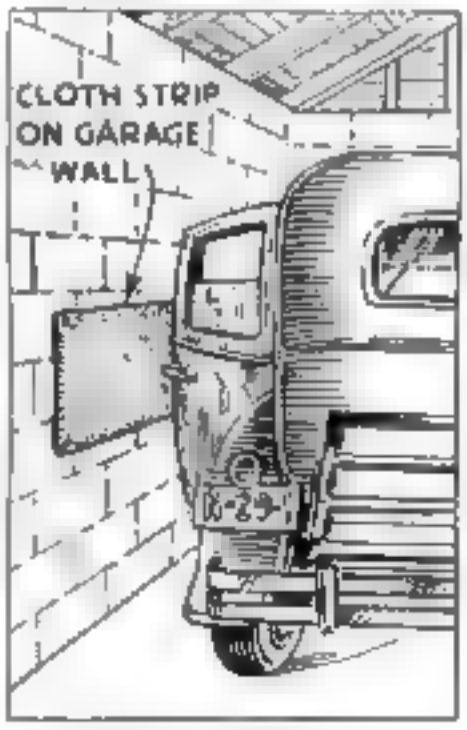
Tire jack placed as shown against wood block and eye of spring helps fasten rear spring to shackle

Closing Rear Compartment

STRETCHING under the raised rear deck of a business coupe often results in a bumped head when the catch slips. In order to prevent this, I stapled a length of heavy cord to the wood frame inside the cover and ran the other end to the middle of the support bracket. Now, I can close the compartment easily and safely merely by pulling the cord to release the latch.—W. B. M.

Pads on Garage Walls Protect Car Doors

BY NAILING a pad of scrap velvet, heavy cloth, or thick rubber along each side wall of a narrow one-car garage the car owner can protect the nickel-plated handles on the car doors from injury. The length of the pads, of course, will depend on the variation in the position of the car.—H. P. B.



Pads of cloth or rubber fastened to garage walls protect car doors

Windshield Wiper Fixed with Wire

Wire wound around blade arm of windshield wiper makes blade touch glass

WHEN your windshield wiper fails to make contact with the glass inspect the spring at the upper end of the blade. With continued use, it often looses its compression. This can be remedied easily by winding three or four turns of wire around the blade arm above the spring, forcing the spring together a small amount to increase the pressure.—R. J. W.

INSIST ON AC

...ALWAYS *THE QUALITY SPARK PLUG*
NOW OFFERED AT *THE LOWEST PRICE*
OF ANY FACTORY-APPROVED PLUG

AC

THE QUALITY SPARK PLUG

Seldom will you find Quality and Economy *so well united in any one product* as in the popular AC spark plug.

AC is so truly *the quality spark plug* that more ACs are used by car builders than all other makes of plugs combined. And yet ACs are *very economical*. In fact, they are now offered at the lowest price of any factory-approved plug.

ACs are *better* spark plugs because of these five *patented* features: (1) one-piece heat-sealed construction; (2) exclusive AC insulator combining great heat-resisting qualities with mechanical strength; (3) welded side-electrode; (4) unglazed insulator tip; (5) Isovolt electrodes. These are technical features, of course—but extremely important. Your dealer will gladly explain how much they contribute to finer engine performance.

When the time comes to replace worn plugs—and the proper time is every 10,000 miles—do as so many motor car builders have done after thorough tests: *Insist on AC, the quality spark plug, and the economical spark plug, too.* 60c each (75c in Canada).

It pays to install new spark plugs every 10,000 miles because worn plugs waste one gallon of gasoline in every ten, and waste power and performance, too.

AC SPARK PLUG CO.

FLINT, MICHIGAN * ST. CATHARINES, ONTARIO

Here's a new Construction Kit everyone can use

NO 5

A BEAUTIFUL

Wall Rack

IN SOLID ROCK MAPLE

OUR new furniture construction kit the hanging wall rack illustrated, is one of exceptional utility and value. The wood used is high grade rock maple, carefully selected for the Popular Science Homecraft Guild from the choicest stock of one of the country's best furniture manufacturers. The parts are all perfectly machined and ready to assemble so that anyone, no matter how little he knows about woodworking, can put them together.

Since the rack is held together securely by eight wedges, it is not necessary to use glue. The drawer, however, should be glued and nailed permanently, and, of course, it will do no harm to glue the rack, too, if you do not intend ever to take it apart again.

Round all sharp edges slightly with sandpaper and give the wood a final smoothing with very fine sandpaper rubbing with the grain. Suggestions for finishing, but not the finishes themselves, are included with the kit. The price is $5.75, shipping charges prepaid to any point in the United States east of the Mississippi River, and $6.25 west of the Mississippi. The new kit is marked No. 5 in the list below. The other kits available are also listed. Each is accompanied by instructions or blueprints.

A. Whaling ship model *Hunderer*. All the raw materials — wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 153, 154, 155, and 154 and a booklet. The hull is 20 in. long $6.00

AA. Same with hull bits sawed carefully to shape 7.50

D. Spanish galleon ship model, 24 in. long. All the raw materials except paints. Blueprints Nos. 46 and 47 and a booklet 6.45

DD. Same with the two main hull blocks shaped 6.95

E. Battleship model U.S.S. *Texas*, 21 in. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200 ..... 6.95

EE. Same with hull bits sawed 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long and Blueprint No. 204 ..... 3.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long and Blueprints Nos. 206 to 208 ..... 6.75

GG. Same with hull blocks shaped 7.25

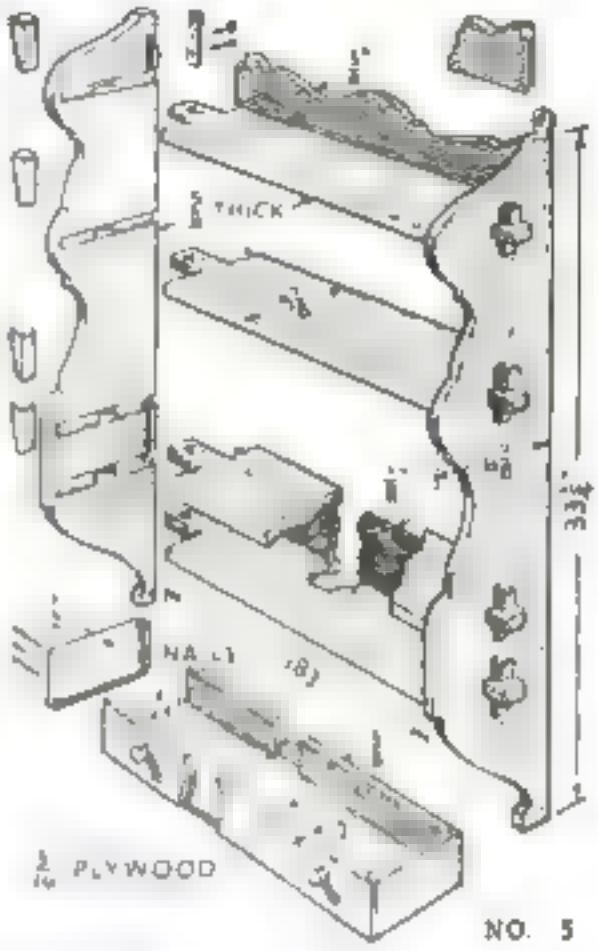
H. Cruiser U.S.S. *Indianapolis*. All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216 ..... 1.50

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble 3.00

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24½ in. high over all. Ready to assemble 5.30

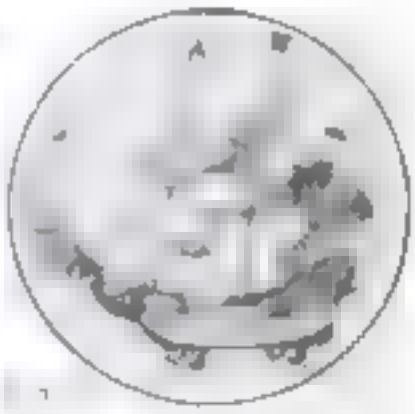
No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble 5.75

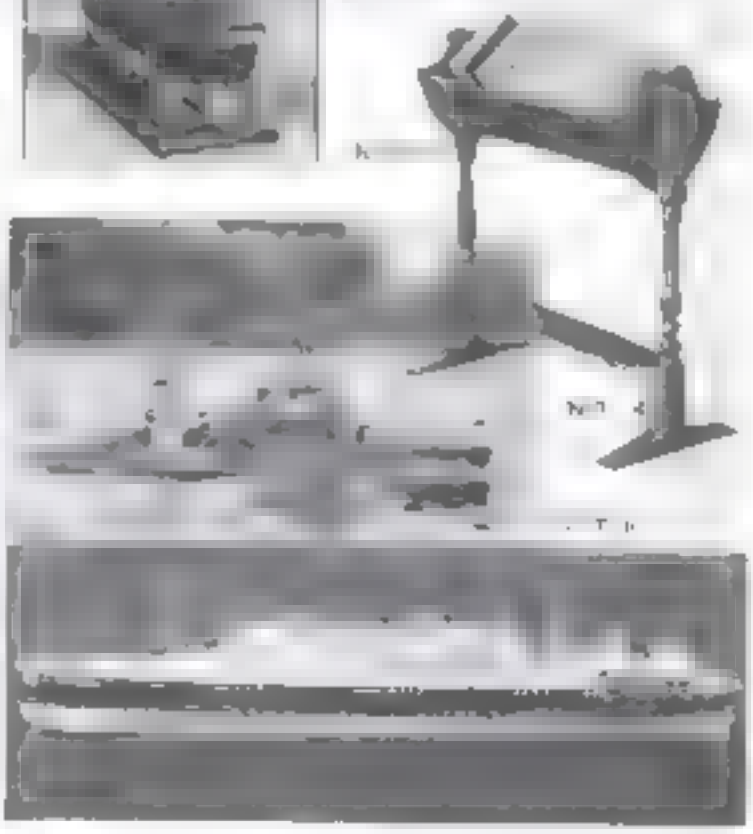
Note. *In addition to these kits,* POPULAR SCIENCE MONTHLY *offers blueprints alone for many projects.* *See page 80*



NO. 5

KIT H





KIT F—Materials for 12 in. model of *Manhattan*

NO 2

KIT A

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me Kit ..... for which I inclose $..... (or send C. O. D. C.)

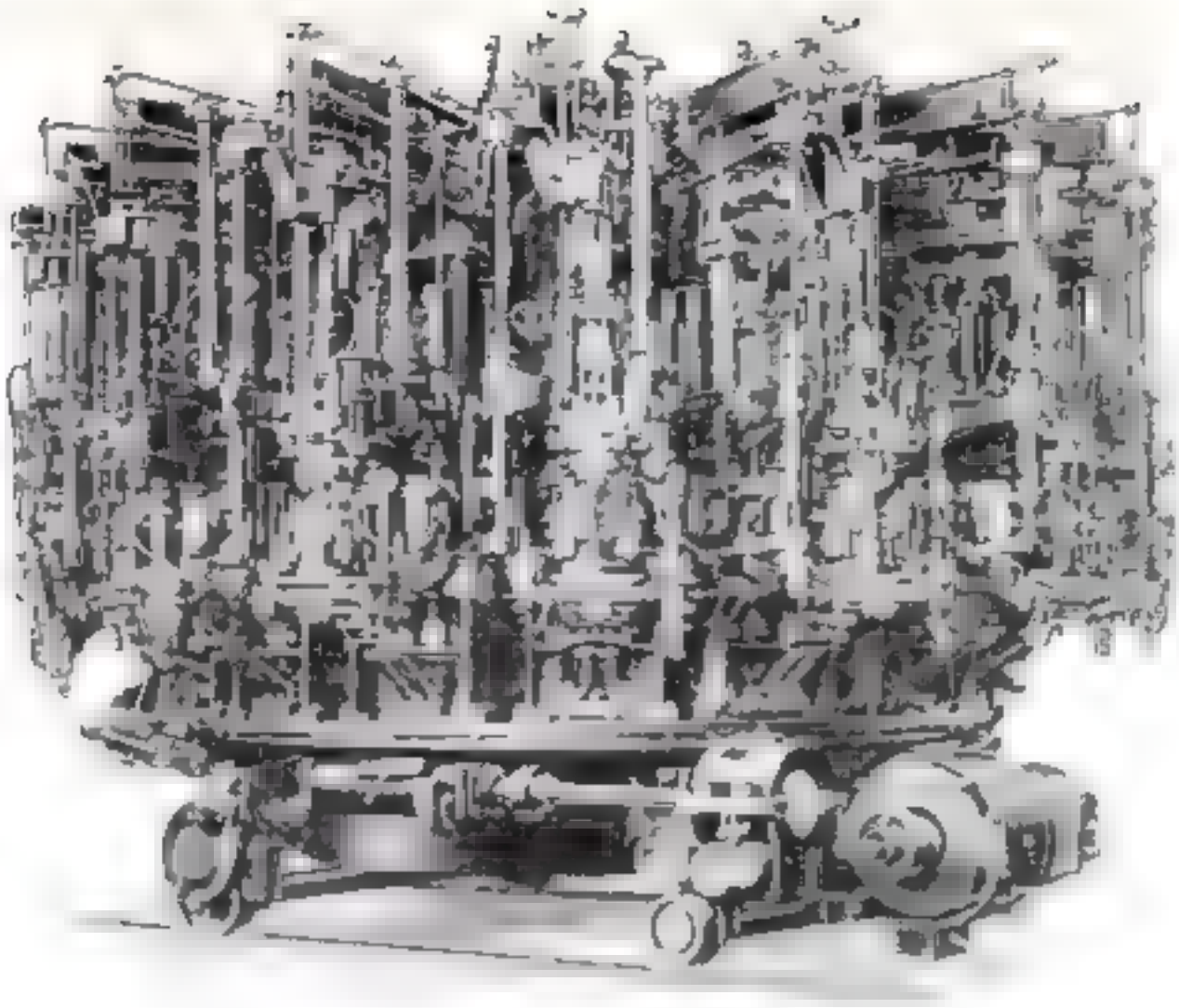
Name .....

Address .....

City ..... State .....

(Please print name very clearly.)

Note. Prices on all kits except *F* and *H* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount ..... Kits *F* and *H* cannot be sent C. O. D. The offer is made only to readers in the United States.



84,672

MOVING PARTS

• Compared with this marvelous machine, an automobile is a simple apparatus; an electric generator is a kindergarten toy. Think of it—84,672 separate pieces of metal, all of which must move and work without a miss if the machine is to perform its function, which is to pick up molten glass from a huge container and transform it into bottles—a million of them every week!

• Were you to see this wonderful machine at work, you would probably be struck with bewilderment. Yet the amazing intricacy of this machine and the other complicated machines of modern industry is brought about by the combination and adaptation of comparatively few basic mechanical movements and principles.

• All of these movements and principles are simply, graphically, and understandably demonstrated and explained in The Mechanical Wonderland, Popular Science Monthly's exhibit at the great Chicago World's Fair. The operation and purpose of levers, cams, crankshafts, pumps, engines, and every other mechanical contrivance known to engineering is made plain by 160 working models, perfect in detail yet so simplified in design that anyone can understand and appreciate them. Almost a million people have seen this unique exhibit. Hundreds have written to tell us that it is one of the outstanding features of the Exposition.

VISIT POPULAR SCIENCE MONTHLY AT THE WORLD'S FAIR

The Mechanical Wonderland, which is presented with the courteous cooperation of the Newark (N. J.) Museum, is on display in General Exhibits Building One, adjoining the Hall of Science.

A *Block Puzzle*

YOU'LL NEVER HAVE TO SOLVE THE SAME WAY TWICE

By *Arthur* L. *Smith*

THE letters forming the words POPULAR SCIENCE MONTHLY can be made into a sliding block puzzle that may be arranged so as to be solvable or insolvable at will. The possessor can place the blocks in the prepared box apparently in a haphazard order and solve it but his friends will have the odds greatly against them of getting the letters in a solvable position.

No matter how the letters are mixed, a solution is possible when the last one is I but not otherwise. Even when they are in a solvable position, the solution is intricate. Figure 1 shows the plan with the letters so placed that they can be moved about until they are in the position of Fig. 2.

It can be shown mathematically that there are more than 258 quadrillion ways of placing the letters, of which 25 quadrillions will permit of a solution. Consequently no solver need work out the same problem twice. In fact, there are a number of trillion ways more than stated but we may consider these negligible.

Cigar box material may be used in the construction, but the puzzle will probably give better satisfaction if a little thicker wood is used for the blocks. In this case the strips on the bottom board, as shown in Figs. 5 or 6, must be of the same thickness. A sliding cover box may be made as shown in Fig. 3, and the completed box

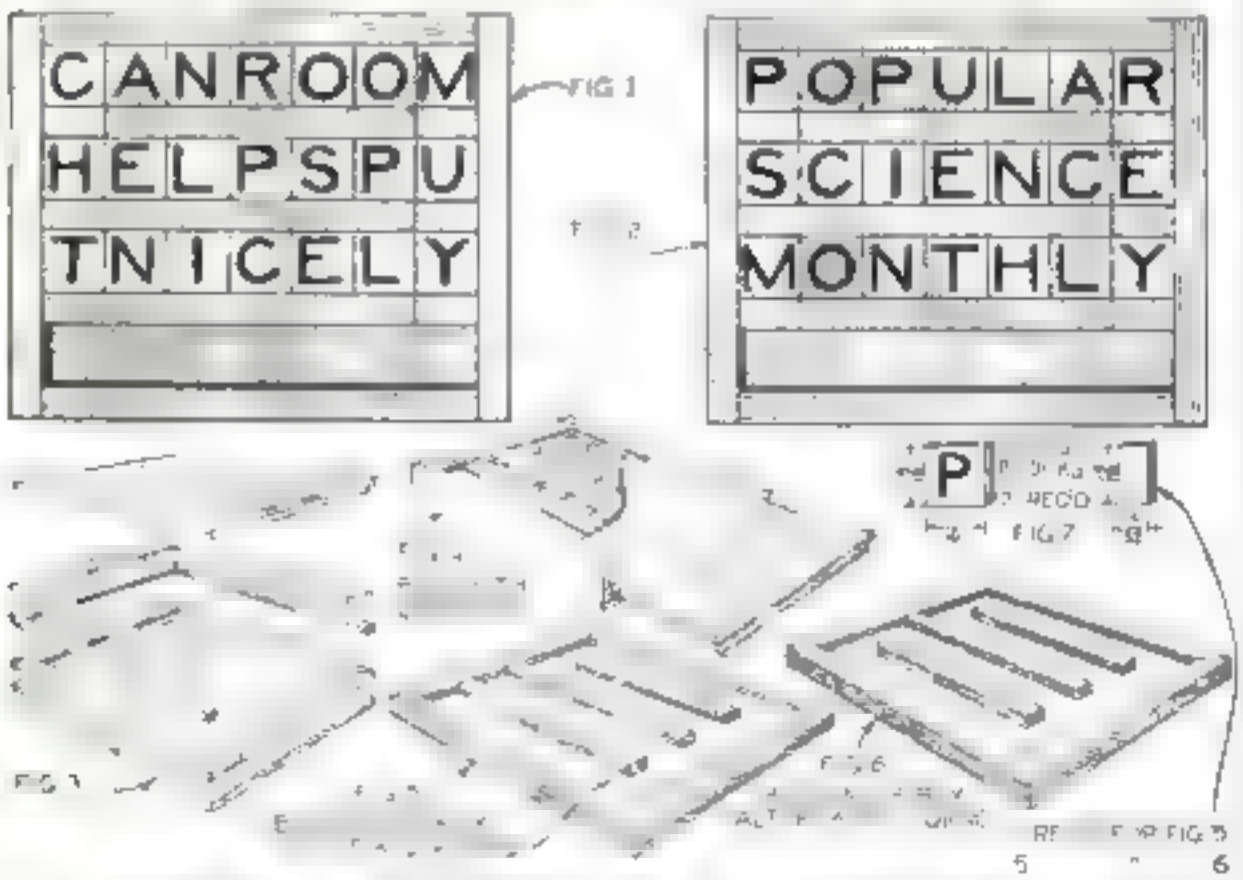
Unless you reveal the secret, your friends have little chance of solving this puzzle

with its contents is illustrated in Fig. 4.

The [illegible] board measures 6 [illegible] by 8 in. The border strips and the inside strips are ½ in. wide. The upper strip, Fig. 5, is 5 in. long. The two lower strips are each 6 in. long. All the strips are fastened to the bottom board with nails or good liquid or casein glue. The spaces between the strips are 1 in. wide, and the spaces at the ends are 1 in. long.

The twenty-one lettered blocks should be slightly less than 1 in. square, say 15/16 in., as shown in Fig. 7, to permit their being moved easily between the strips. A great deal of disappointment will be avoided if particular care is taken to have them true to size and perfectly square. The letters may be burned into the wood.

Four blank blocks, 15/16 by 15/32 in., as shown in Fig. 7, are required to fill the end spaces left by the strips in Fig. 5.



One of the 25 quadrillion solvable arrangements (Fig. 1), and the final position (Fig. 2). The other drawings give the details. Figure 6 is a much simpler arrangement than Fig. 5

These are movable. The sharp edges of all the movable blocks should be sanded off.

The space between the lower strip and the border is left vacant to permit blocks being moved into it. In moving, the narrow blank blocks are to be kept horizontal and are not to be twisted into an upright position. If solvers show a tendency to do this, a full sized square blank may be substituted for the narrow block below block *V*. Then nothing will be gained by twisting the others.

It will be noticed that the order shown in Fig. 1 forms the words *"Can room helps put nicely."* This is an anagram on POPULAR SCIENCE MONTHLY which suggests the editor's willingness to consider useful suggestions. It would be more grammatical, perhaps, to say *"Can room nicely put helps,"* but this order will be unsolvable unless another narrow block is introduced as indicated by the dotted line below the right-hand edge of *M* in Fig. 2 and by the alternate bottom board shown in Fig. 6. This modification will make any order of letters solvable but the solutions will be correspondingly easy.

Other anagrams on POPULAR SCIENCE MONTHLY are: *"One par in copy tells much"* and *"Run! Help! Iceman lost copy,"* the latter a solvable order.

Solutions will vary according to the order of letters, but one solution for Fig. 1 will be given next month.

ADJUSTABLE WIDE STEP FOR USE ON LADDER

This wide flat step relieves the strain of standing on a ladder rung for long periods

ANYONE who has worked for long periods while standing on the rungs of a ladder will welcome the comfortable step illustrated in the photograph above. It is merely a 1 by 6 in. board long enough to fit between the uprights. To each end is fitted an L-shaped strip of iron ⅜ in. thick and 1¼ in. wide. One end of each strip is bent to fit over the rung, and at the upper end five ⅜-in. holes are drilled 1 in. apart to allow the step to be adjusted level. Two iron rods, ⅜ in. in diameter, are bent as shown, and the bottom of each, where it fits into the holes in the strips, is given a slight upward turn to prevent slipping.—H. R. PAGE.

Preventing Model Railway ACCIDENTS

Herman W. Overbeck *tells how to keep your trains on the track*

Fig. 1 (*left*). Guard rail prevents a car from tipping on a sharply elevated curve. Fig. 2 (*below*). Bent coupling causes Pullman when it to rise up clear of the track

EVERY model railway owner who delights in operating his trains at high speed knows that derailments are most likely to occur at the curves. This is especially true if the track layout is made from the ordinary factory made sheet metal track. Sharp curves and high speed do not go well together.

Of course, an occasional derailment is no serious matter under usual conditions, but if a portion of the track that includes a curve is elevated, cars going off at this point are sure to be dented or mechanically damaged by the fall to the lower level.

Figure 1 shows a cure for derailments at such points. It consists of a guarding fence rail set close enough to the track to keep the locomotives and cars from tipping outward too far.

The fence posts should be nailed to the outer surface of the curved strip, which can be of thin wood, say 1/16 by ½ in., and the lower ends of the posts are then nailed to the edge of the elevated platform on which the track is laid. If you do not wish the guard rail to

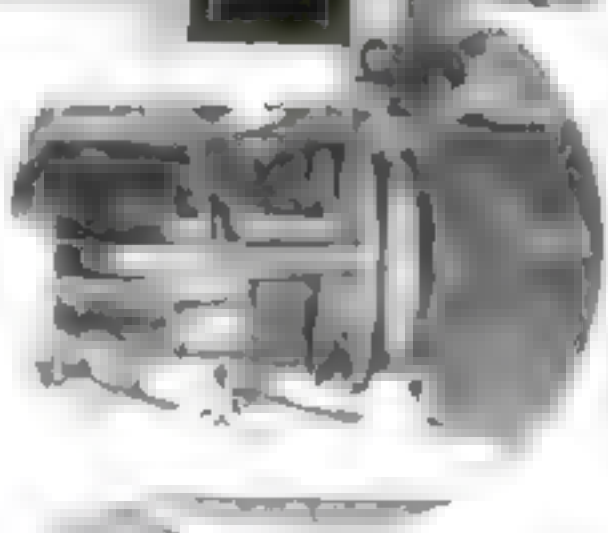


Fig. 3. This contact roller sometimes caused mysterious derailments when it hit against a switch frog or a curve

Fig. 4. The maximum banking angle for a box car and a passenger car was discovered to be 15 degrees, for a locomotive, 20 degrees

be too conspicuous, give it a coat of black or dark brown paint. It will rarely be noticed.

If you have continual trouble with cars going off the track at curves and switches, even when the trains are operated at slow speed, your first thought is that something is wrong with the curved pieces of track or the switches have become bent. If an inspection shows the track layout in good shape at all points, then the difficulty may be a more obscure trouble. Figure 2 shows one of these mysterious defects "caught in the act." Look carefully and you will see that all three wheels of the heavy Pullman car truck nearest the locomotive are lifted clear of the rail. The truck was not propped up for the photograph, it was lifted into that position every time that particular locomotive and car hit a curve. Careful examination showed that the coupler on the car had become slightly bent through a collision. It coupled freely and seemed all right on straight track, but on a curve it cramped so badly the car was lifted off the track as shown.

BENDING the coupling back into proper position eliminated all trouble with that train. Because the end of the car is lifted in such cases only at the curves and the lifting is quite smoothly done, careful observation is required to single it out from the normal movements of the train.

Another cause of derailments that is still more baffling, although fortunately more rare, is shown in Fig. 3. An ordinary passenger car of somewhat ancient vintage suddenly developed a tendency to hop off the track without any apparent provocation. Sometimes it would leave the rails at every curve; then it would behave itself for quite a while only to start jumping the tracks every time it passed over a switch.

A careful examination showed that the contact roller which supplied current to the car light was to blame. Partly through natural wear and partly as a result of a wreck in which this car was involved, the contact roller supports had become worn and bent sufficiently to allow the roller to swing off to one side so that its edge caught on the third rail as Fig. 3 shows. This did not affect the operation of the car on straight track, but it is easy to see what happened when it struck a switch frog or a curve when in that position. The cure, of course, was to bend the roller support so that it doesn't project downward far enough to permit this side swing.

THE question often arises as to what is the maximum bank permissible on the curves of a model railroad, and the best methods of banking the track. Figure 4 shows the result of an interesting experiment along this line. A locomotive, a passenger car and a box car were set up on straight pieces of track on a table that had been carefully leveled. Then the track sections were tipped up by means of pieces of small cardboard squares to the point where the locomotive and cars would just remain on the track. It was found that the locomotive would remain on its track up to an angle of 20 deg. Both the passenger car and the box car fell off when the angle was made to exceed 15 deg. The difference is, of course, due to the fact that the low-set motors give the locomotive a lower center of gravity.

It is obvious that the maximum banking angle cannot exceed 15 deg., as otherwise a train will be tipped off the track if it happens to stop on a curve.

Furthermore, if a train is stopped on a curve that is heavily banked and the locomotive is started with a jerk, the yank will be in the direction of the low side of the bank and the whole train will be derailed—or at least that portion of it on and close to the curve.

Ten degrees is probably the stiffest banking for curves that would be practical if you expect to stop trains (Continued on page 81)

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(Construction kits are available for some of these models. See page 74.)

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on the curve. And with 10-deg. banking, you will have to be careful about starting a train unless you are backing it, in which case the thrust tends to hold the cars on the track. Of course, you could tip the track up to 15 or even 20 deg. for the curve at the bottom of a long down grade, and it certainly would permit high-speed operation around that curve, but you would have to be careful never to allow a train to hit such a steep bank except at high speed.

In any case, banking should start several sections back of the curve on each side so that the tipping motion of the train will not be too abrupt. The simplest way to bank track is to fasten it down with suitably sized blocks of wood under the outside end of each cross tie.

If you have more than one locomotive and your track layout includes a crossing, you are

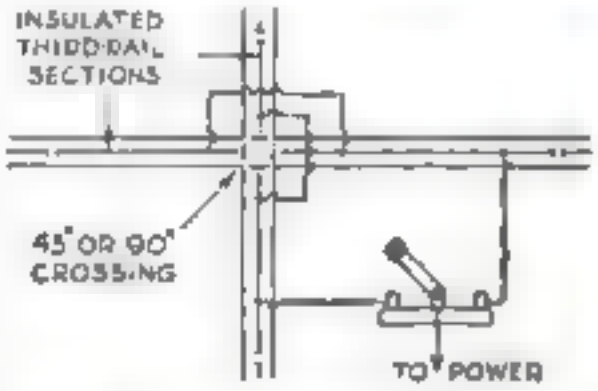


Fig. 5. Collisions at a model railway crossing can be prevented by this method of wiring.

almost sure, sooner or later, to have a damaging collision at the crossing unless you take steps to prevent it.

Figure 5 shows a way to control a crossing so that a collision is an absolute impossibility. No apparatus is required except a cheap single-pole double throw battery switch.

A study of the diagram will show you that current is supplied to the track through the crossing in one direction when the switch arm is in one position, and in the other direction when the switch is moved to the other jaw. Obviously, the switch cannot be in both positions at once and therefore two trains can never reach the crossing at the same time.

If desired, red and green signal lights can be connected into the circuit in parallel with the track sections to give a more realistic effect. The length of the isolated third rail sections supplied by the two-way switch will depend on the coasting distance of your trains. The sections should be long enough so that a train approaching the crossing at full speed will stop before reaching it if the switch is set for the other direction.

TIN FILINGS OVERCOME BRAZING TROUBLES

A PERFECTLY smooth and uniform flow of metal in difficult brazing jobs can be obtained by adding one part of black tin filings to ten parts of the borax used as a flux. Ordinarily there are times when the brazing metal refuses to flow except in spots. I have had this experience when brazing special nickel steel connections to copper covered steel tubing used for acetylene gas piping. The use of the tin filings, however, overcomes this difficulty quite satisfactorily.—HAROLD BLAIR.

MOUNTING PRINTS ON MUSLIN

TO MOUNT blueprints, maps, or large prints on muslin, first stretch the muslin on a frame and wet it. Then coat the back of the print or map with a paste made preferably of rice flour and press it on the moistened muslin, being careful to avoid wrinkles and air blisters. Do not remove the muslin from the frame until thoroughly dry.—C. K.

Smoking Stand

. . . . DESIGNED ON SIMPLE, MODERN LINES

By *Herman Hjorth*

A SMOKING stand of modern design such as the one illustrated is a useful little piece of furniture, and it can easily be made from odds and ends around the shop. By varying the height and width or by adding a shelf, the stand may be used for other purposes—for example, an end table, a coffee table, or a stand for a large ornamental vase, flowerpot, or statuette.

The construction is quite simple. First, plane the stock for the legs and the top crosspieces, which have a cross-lap joint, because these parts are of the same width and thickness. It is more convenient to make the cross-lap joint from one piece 20 in. long instead of from two pieces 10 in. long since it is easier to plane one piece to dimensions than two.

When laying out the joint as shown in the detail drawing, be careful to get it in the center so that the four arms of the joint will be of the same length. If the joint should be too tight, do not try to force it together and do not try to make the cuts wider. It is much easier to plane a little off the sides of each member to reduce their thickness.

Plane the bottom, which is eight-sided, to exactly the same width and length as the cross-lap joint.

The joints in the legs where they fit over the bottom and the cross-lap joint are now laid out and cut as shown on the detail drawings. Place the legs edge to edge and square lines across them all at the same time. In this way the bottom and the cross-lap joint will be exactly the same distance apart on all four of the legs.

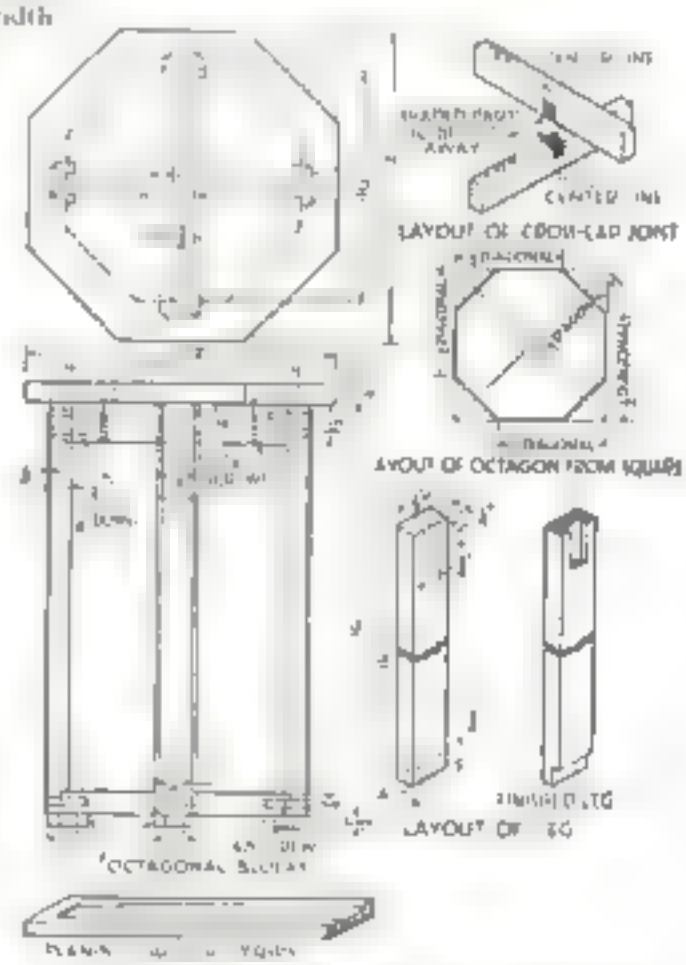
The grooves and rabbets should be cut ⅜ in. deep. It is best to saw part way down inside the lines for the grooves, as the wood splits easily lengthwise when a chisel is driven in with a mallet. Saw the rabbets across the grain and chisel from the end. Finish all grooves and rabbets with a router plane, if available. It is very important that they are all cut to the same depth.

The stand may be doweled or screwed together. If dowels are used, they should be ½ in. in diameter and at least 1½ in. long. Lay out the position of the dowels on all the legs. Clamp the joint, the bottom and two opposite legs together while boring for the dowels. If the dowels are cut ⅛ in. shorter than the depth of the holes, the clamps can be placed over them and the stand clamped tightly together when gluing. Put glue in the grooves and rabbets and on the ends and edges of the cross-lap joint and bottom. Dip the dowels in glue and drive them home.

Before gluing, four 7/32-in. holes should be bored through the arms of the cross-lap joint, 1½ in. from the ends. They should be countersunk on the underside so that the top can later be fastened to it with screws.

The ⅝ by 1½ in. strips of wood, which cover the dowels or the screws as the case may be, can be planed and smoothed with scraper and sandpaper in a jig as shown on the drawing. They are located on the legs with two small brads, which can later be withdrawn. Clamp a piece of wood over the strips while gluing.

The top should be made from two or three boards glued together rather than from one wide board, which is more likely to warp. Joint (plane) the edges of the boards by clamping them side to side and planing



Assembly drawings, details of the cross-lap joint, legs, and planing jig, and how to lay out an octagon

two at a time. Be sure that the joint fits.

After the top is planed and smoothed to size and shape, it is placed face down on the bench with the lower part of the stand on top of it. Be sure that the grain of the top runs in the same direction as that of the bottom. Center the top by measuring from its edge to the face of the leg. Fasten with 2-in. No. 12 flathead screws

The feet for the stand may be sawed from a piece of wood planed to an octagonal shape lengthwise

After a thorough cleaning up and sanding, the stand is ready for finishing. It may be stained in two tones or painted in two colors. Clear and colored lacquers may also be used. In any case it will be most effective if the strips and edges of top, bottom, and feet are stained or painted a darker color than the rest of the stand

An alternate design in which top, bottom, and feet are circular

If the stand is stained, it may be finished with three or four coats of very thin shellac. The shellac should be thinned with alcohol until it is as thin as water Let each coat dry at least two hours and rub down with No. 2/0 or 3/0 steel wool. Finish the last coat by rubbing it with crude oil and No. 5/0 waterproof sandpaper or powdered pumice stone.

List of Materials

No. of pieces	Description	T.	W.	L.
4	Legs	[illegible]	1½	6
4	Strips for legs	[illegible]	1½	6
1	Cross-lap joint	[illegible]	1½	20
1	Bottom	[illegible]	9	10
1	Top	¾	12	12
4	Feet	¾	1½	1½
16	Dowels	¾	round	1½
4	Screws	2-in. No. 12		
4	Screws	1-in. No. 8		

FASTENING MACHINERY TO CONCRETE BASE

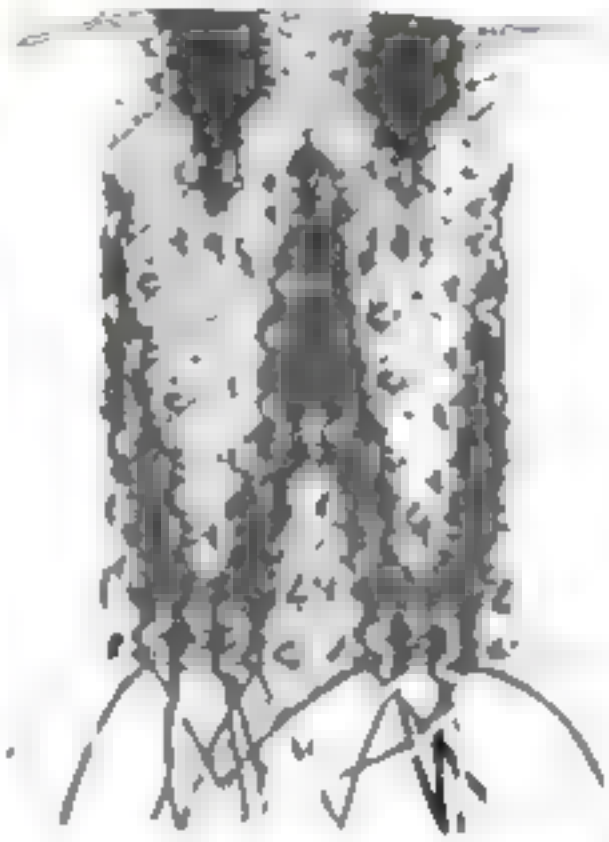
MACHINES may be fastened to concrete floors with lag screws if the concrete is thick enough. Drill a hole with a star drill ¼ in. larger than the diameter of the screw See that the floor is level where the machine is to be set, and measure carefully where the holes are to be drilled If the machine is not too heavy, place it in position, mark the holes, and then move it to one side while drilling them. Make the holes larger at the bottom by slanting the drill, or use a smaller drill to do this

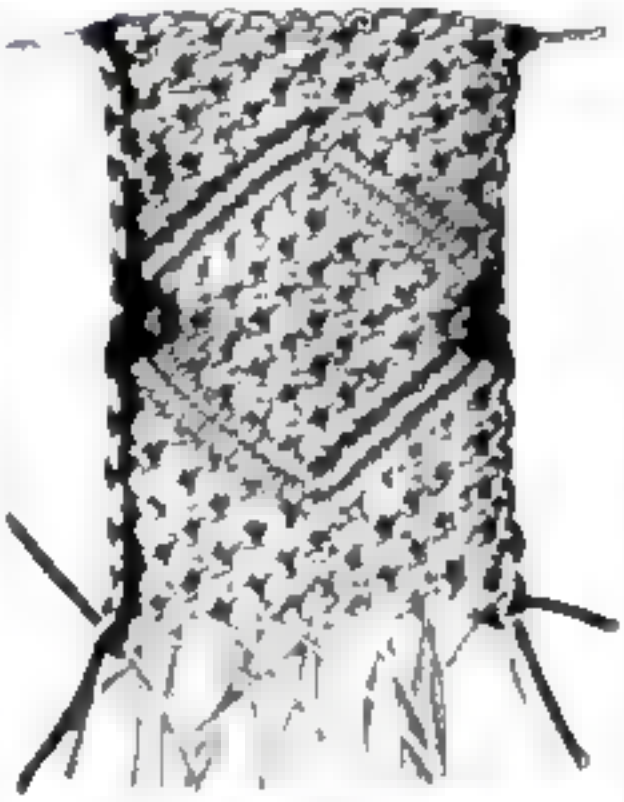
To hold the screws temporarily in a vertical position, twist two wires around the shank and spread the ends out to rest on the concrete. Dip the screws in hot paraffin, but only enough to give them a thin coat place them centrally in the holes, supported by the wires, and pour melted scrap lead around them. When the lead has set hard, take out the screws, remove the wires, place the machine in position, and turn down the screws with a wrench

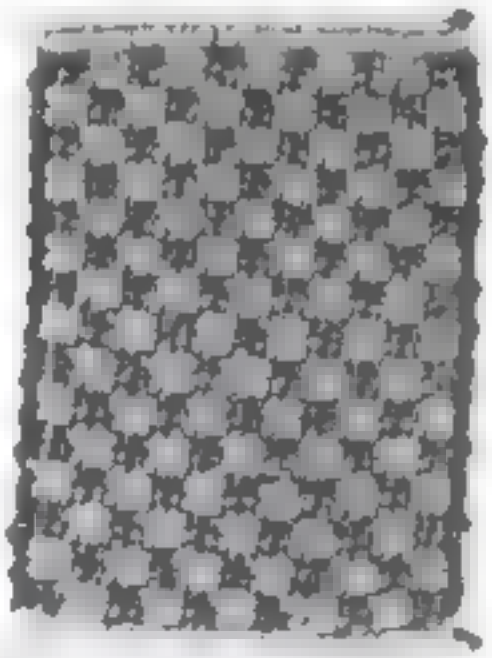
This method is especially useful in damp places, for imbedded bolts may rust off and to renew them the concrete itself must be replaced. If a lag screw rusts off, merely replace it.—CHARLES L. H. INTEMANN

SQUARE-KNOTTED CIGARETTE CASE

(Continued from page 6)







Four other designs that may be worked into the front of the case. The two at the top are combinations of square knotting and rows of half Chinches. The lower ones are made by half hitching over a single filler cord in a way similar to that used in making one design shown in our recent article on wampum belts. P. S. M. May '33, p. 53; center view at bottom

tance of 1 in. Push the ends through to the back of the white piece, tie securely, and cut off short.

What remains is to tie the loose cords from the short right angle pieces to the sides of the main piece as shown in the photograph at the bottom of page 6. In doing this, the case is wrong-side out. Find the exact place for joining by folding the container over a pack of cigarettes. Make the knots small and cut the ends short. Then turn the case inside out and it is completed.

For other projects in P. S. M. Nov. '32, p. 77; Mar. '33, p. 68; Apr. p. 74; May p. 63; June p. 82; July p. 65; Sept. p. 65.

CLEANING THE PIPES OF AN OIL-BURNING STOVE

To clean the oil feed tubing and valve parts of an oil stove or burning range it is not necessary to dismantle the unit. Remove the oil container, unscrew the union that connects the feed pipe to the valve plate, drain the oil, and thoroughly clean the reservoir. With a piece of insulating tape, connect a tire pump to one outlet at a time and blow out the entire system. You may make an improved lighter for a stove of this type by cutting a piece of lamp wick just wide enough to be inserted into a discarded brass curtain rod of small diameter. The wick can be pulled out from time to time as required.—H. J. CHAMBERLAND.

When ordering back issues of POPULAR SCIENCE MONTHLY, *please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.*

SHIP MODEL HULLS

(Continued from page 69)

the profile, including the sheer, and cut to these lines. These pieces will, of course, be cut right and left. Then make the templates and shave down as before. If you have access to a band saw or even a circular saw, it will save considerable labor.

To make a bulwark, take a piece of thin whitewood or white pine about twice the depth of the bulwark, lay this along the hull outside, fastening it with thumb tacks if necessary, and use a sharp pencil to mark on it the line of the deck, meanwhile holding the forward end to the correct flare-out. Cut accurately to this line and, measuring from that edge, mark the right height and cut nearly to it. Glue and lightly nail this in position, whether placed in a rabbet in the hull or set to the waterways. It may be, but seldom is, necessary to steam the forward end or steep it in boiling water until pliable.

The remaining work consists of the small deck fittings, spars, and rigging. For the deck houses and the like, you will use your judgment whether to build them up or cut them from the solid. Spars and other small fittings will be described in a following article.

ELECTRIC GLUEPOT

(Continued from page 70)

rivet heads to guard against possible short circuits. Examine the wiring carefully, and then coat the whole with a 1/4-in. layer of furnace cement. Fill the can with water and hook up the low heat to bake the cement securely in place.

All that remains is to fit the switch. Use a hardwood block for the base, boiling this in paraffin to make it waterproof. The contact points are threaded from 3/16-in. stock, and should be properly spaced to take a standard electric-iron plug. Arrange the contacts—low, second, and high—to correspond with the gear shift of your car. The central post, of course, is the common terminal for all heats. Assembly of the switch is best done by hooking the wires to the posts, then fastening the posts to the block, and finally fitting the block to the can by means of machine screws. If you use bare wires, make certain that they go in as widely separated as possible.

Paint the cans aluminum and the switch black.

TURNING LARGE CASTERS

In moving pianos and other heavy furniture over hardwood and cement floors, the work can be greatly facilitated by using a monkey wrench to turn the casters in the direction in which it is intended to move the piece. In the case of hardwood floors, the finish is much less apt to be marred than if the piece were pushed by sheer strength without considering how the casters happen to be set.—H. O. Carrington.

Wanted . . . from Model Railway Fans

short articles, hints, suggestions of interest to all those who have a miniature railroad system or intend to build one. Each item should be illustrated with one or two clear photos and, if necessary, a pencil sketch. The text should not exceed 200 words.

CAMERA TROUBLES: HOW TO CURE THEM

Concluded from page [illegible]

back and carefully inspect every crease and crevice as you move the light back and forth. Of course, other lights in the room should be turned out. When you spot the hole, cement over it a thin piece of leather such as may be cut from an old glove. Use any of the flexible cements recommended for leather. Be careful to place the patch so that it will not interfere with the folding of the bellows.

It also is possible to have a light leak through the camera body, although this trouble is rarely encountered. When it does happen, it usually is at some point in the joint where the back opens to permit loading the film. Such a leak is difficult to find by any simple, direct test, but it often can be located by a careful inspection of the joint at all points. In most cases it will be found that the edge of either the back or the opening in the camera body has become bent or damaged in such a way that the light is not stopped by the usual two right angle corners.

Sometimes, indeed, the mere chipping away of the black paint at the bottom of the grooves of the joint, if the body and back are made of aluminum, will permit enough light to be reflected around through the joint to cause fogging. This is often the cause of mysterious cases of occasional fogging in a camera that normally gives no such trouble. The camera may, for example, be left for several days where strong light strikes the bad place in the joint, thus spoiling one of the films.

Touching up with flat black paint often is all that is necessary to get complete light tightness. Furthermore, a camera should be kept in a case at all times when not in use.

Every amateur photographer occasionally makes a mistake in judging the distance to a nearby object and the result is a fuzzy out-of focus picture. When, however, picture after picture is fuzzy, in spite of the most careful focusing, especially if the detail is all shot to pieces at one or both ends of the film on horizontal shots, it is time to look for serious trouble.

At the time a camera leaves the factory the axis of the lens is exactly perpendicular to the plane of the film, and the focusing scale is correctly adjusted. Subsequently, a jar or bump may throw these settings out of true. The lower of the two views of a room interior shows what may happen. This picture was taken with a folding camera after its owner had accidentally dropped it and the lens support had become bent backward. Note how fuzzy are both sides of the picture. Anyone casually glancing at this view would at once condemn the lens as being a poor one. Yet see what happened after I bent the lens support forward till the axis of the lens was at right angles to the film. The upper of the two pictures was taken from virtually the same point of view, same lens opening, same shutter speed, same lighting, same everything except that the lens was occupying its correct position. It is quite obvious, from a study of these two pictures, that a jar or bump on the lens standard is a serious matter.

A small electric lamp pushed into the extended bellows aids in finding pinhole leaks

If you have reason to believe that your own camera is not quite right in this respect, it is an easy point to check. All you need is any standard type of carpenter's or machinist's square fitted with an ordinary bubble level. Place your camera on a firm table as shown in the photograph at the beginning of the article and put strips of paper or cardboard under the front or back of it till the square placed against the back shows that it is absolutely vertical. Now carefully place the vertical leg of the square so that it contacts both upper and lower edges of the lens barrel. If the bubble is in the center, your lens is perfectly true in that direction and you can repeat the test with the camera set as for taking horizontal pictures.

A slight error is allowable — perfection is difficult to attain — but anything more than a slight displacement of the bubble indicates that the lens support should be trued. Unless you are an expert mechanic, this job should be turned over to a competent camera repair man.

Aside from the effects already shown, any forward or backward bending of the lens support also throws the focusing scale out of adjustment, since it moves the lens as a whole nearer to, or farther from, the film than the point for which the focusing scale is set.

Once in a while the focusing scale is incorrectly set. A more common trouble is that the focusing scale pointer has been accidentally bent.

Checking the focusing scale of any roll-film camera—and that also includes home movie cameras—is neither difficult nor complicated. Anyone can do it. All the apparatus you need is a sheet of white paper, a pair of scissors, a fountain pen, and a tape measure. First cut the paper into rectangles about 7½ by 1½ in. Make a large zero on one piece cut slightly larger than the rest. Then letter two pieces with a large figure *1*, two of them with figure 2, and so on up to 9. Bend each so that it will stand upright.

Place the camera on a box about a foot above the floor, or above the ground if you wish to do the job outdoors, and place the figure *0* at the distance from the lens you wish to check on the focusing scale. Place the other numbered papers in two rows, one leading toward the camera and the other away from it.

Assuming that the focusing scale is correct, taking a picture will give you the result shown in the first of the diagonal views on page 70. The figure *0* will appear sharp, and the other numbers will appear progressively more fuzzy.

If, however, your focusing scale is not correct, you may get a result such as is shown in the second diagonal view.

The remedy depends on the construction of the camera. Either bending the pointer or changing the position of the scale will do the trick.

STOOL HEWN IN SINGLE PIECE FROM BIG LOG

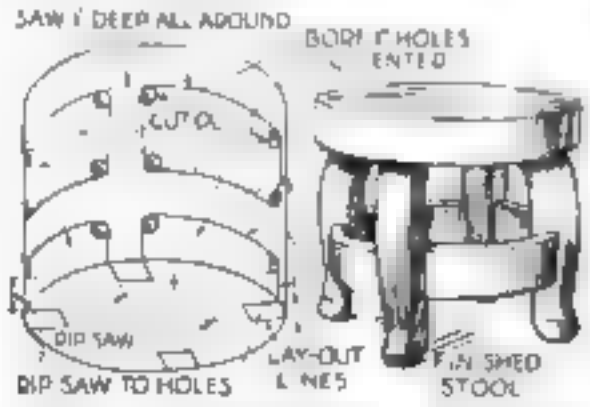
CUT in one piece from a short section of a large log, a stool like that illustrated arouses the curiosity of all who see it, yet it can be made with comparatively little difficulty.

This particular stool is 15 in. high and was hewn from a log 18 in. in diameter. The legs are 3 by 3 in. in cross section at the point where the lower band is placed. If a larger or smaller log is used, these dimensions may be modified.

Select the end you wish for the top, saw it off square, and give it a coat of linseed oil to retard checking. With a tape and a carpenter's steel square, lay out the legs and lower band and draw them on the log. Make a 1 in. deep cut 3 in. below the top all the way around, using a hand saw. Bore large holes where shown below, boring to the center. Try to bore the upper holes parallel with the plane of the top. Saw along the line of the band as deep as possible without cutting across the legs. Cut the lower part of the legs up to the lower line of the band with a rip saw. Using mallet, chisel, and axe, remove the wood between the legs, taking care not to split the band. Shape the legs roughly and then lay out the band 1 in. wide and 3 in. high. It should meet the legs evenly all around. Split off the surplus wood with a chisel and finish the legs and band.

Leave the circumference of the top as nature shaped it, provided it is not too irregular. Fill any checks with a plastic wood composition and smooth the top with block plane, file, and sandpaper. Coat the piece with shellac, followed by varnish or, if you prefer, furniture wax or polish.—CHARLES WHITTICK

This remarkable one-piece stool, which was hewn from a big log, never fails to arouse curiosity



How the log is laid out, where the holes are bored, and a sketch of the completed stool

First-Aid Kit

PREVENTS SUFFERING ON THE TRAIL

The unfolded kit and its case which is strapped to the belt as shown at the right

By

Leonard F. Merrill

Expert woodsman and Home guide

THE man wise in the ways of the woods does not take chances with his health when it can be avoided. A little accident, the scratch of a thorn or bramble, a mosquito bite, if not attended to, may be the cause of very painful and even fatal ailments such as blood poisoning or gangrene.

A drug store is not found at every turn of a woodland path, and [illegible] will look [illegible] many miles before [illegible] and a doctor, so the wise man prepares for emergencies before he hits the trail for the country beyond the edge of civilization.

The emergency or first-aid kit to be described was assembled by the author and has proved, after several years' experience, to be all that is required for minor accidents and common aches and pains. It is compact, [illegible] and complete, and the hunter and trail-man will do well to make himself one like it.

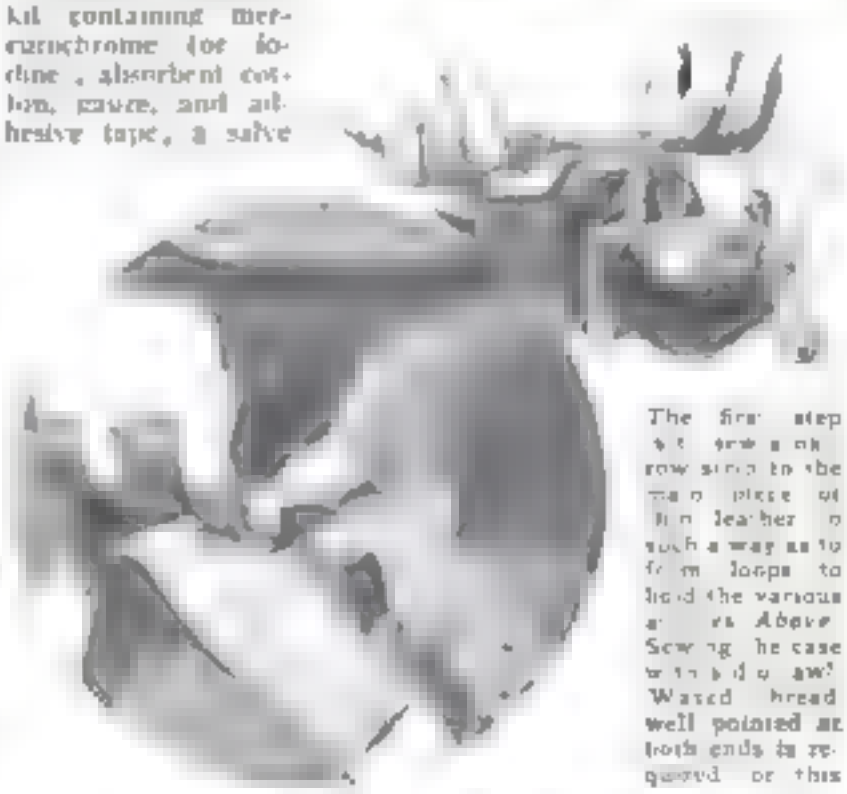
Contents of Kit. The first step in making the kit is to assemble the following: Blunt-pointed scissors and sharp-pointed tweezers, a commercial first-aid kit containing mercurochrome (or iodine), absorbent cotton, gauze, and adhesive tape, a salve for [illegible] the unguentine type, laxative pills [illegible] cotton on round toothpicks and wrapping them in paper, and toothache gum [illegible].

Materials. A piece of thin leather or canvas [illegible] as wide as the tweezers are long and about 15 in. long, another piece of the same material 1 in. wide and 18 or 20 in. long, a piece of leather (or canvas) somewhat heavier than the other and about 14 in. [illegible].

The Kit. Place the scissors at the lower end of the thin piece of leather and make a loop over them with the narrow strip by sewing the strip onto the other leather close to the sides of the scissors. Leave about 1 in. between the scissor handles and the tweezers and make a loop for the tweezers. The narrow strip of leather need not be cut between each of the loops, but may be sewed to the backing piece of leather. The first-aid kit in its cardboard container comes next, followed by a vial of the laxative pills, toothache gum, unguentine, applicators, and safety pins.

After all loops have been made, insert the articles and fold the kit. To fold it properly, the lower or scissors end should be folded up first until it is snugly over the top of the first-aid kit, then the other end is folded on top of that. The top or safety-pin end is now measured and cut off leaving room enough to put a glove snap fastener on it. Put the top half of a snap fastener on this top end, and after it is in place mark the position of the lower half of the fastener and put that on. This completes the kit except for a little trimming at the corners as shown.

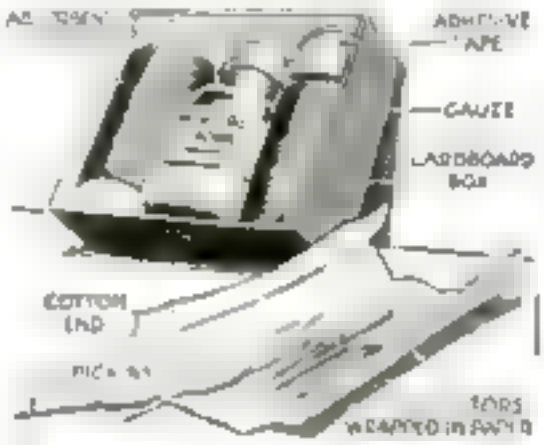
Carrying Case. Place the folded kit on a piece of paper and mark around it to make a pattern the correct size. After marking around the kit in the first position, turn the kit up on its edge and mark around it again. Be sure that the lower bottom edge is on the same line that it was in the first marking. Do the same to both ends and the top



The first step is to sew a narrow strip to the main piece of thin leather in such a way as to form loops to hold the various articles. *Above*: Sewing the case with a awl. Waxed thread well pointed at both ends is required for this

edge, placing the kit back in the first position and then turning it to the new position before making each tracing. To the top edge, which is to be the cover, add a length equal to one half the width of the kit. On the sidepieces or ends add about ⅜ or ½ in. to allow for the seams. On each side of the top, add ½ in. so that the cover will project slightly over the sides when the case is finished.

In sewing the case, the bottom of the end piece is sewed to the middle piece first, then the other end is sewed all the way up, and finally it is necessary to go back to the other end and finish that. The case may be



The box, which contains antiseptic cotton, gauze and tape, is purchased. The applicators are prepared at home

raveled instead of sewed if you so desire, but it will stand more abuse if sewed.

Cut two slits in the back of the case long enough to accommodate the belt and about 2 in. apart. Put the top half of a glove snap fastener in the cover piece and the lower half in the front, and the whole job is finished.

If you are expecting to travel in a section of the country that has poisonous snakes, you should include in your kit one of the small, flat snake-bite outfits that are sold ready made up. These are obtainable at most drug stores in the snake section and can be included either in the kit itself or carried in the case with the kit.

STAIN MADE FROM STEEL WOOL AND VINEGAR

An inexpensive and unusual stain for wood is made by breaking up a quantity of steel wool in vinegar and allowing it to stand for a few days. It should be experimented with daily because, as the steel wool disappears, the solution will become darker. All shades can be obtained from a weathered gray to brown and then black. When the desired tone is reached, the remaining steel wool should be taken out. The color of the stain will then remain constant. Imitations of weathered, antique, or burned finishes can be obtained by applying the stain to the wood and rubbing with rottenstone and liquid floor wax.—C. E. Avery.

CUTTING LUBRICANT FOR HOME MACHINISTS

When the home machinist requires a small quantity of cutting lubricant and coolant, he can mix an acceptable substitute for the commercial product by taking equal parts of motor oil, lard oil, and a fairly strong solution of caustic soda.—H. J. C.

BAMBOO FOR CRAFTWORK

A few clumps of bamboo planted in my yard in Wichita, Kans., several years ago now produce about fifty shoots from 8 to 12 ft. long each year—useful material for making model airplanes, kites, garden stakes, and even light fishing rods.—R. E. D.

POACHING MADE BIG BUSINESS BY GANGS

(Continued from page 31)

shrewdly guessed how the money had been obtained and notified the government. Federal men traced the check to a St. Louis fur dealer and brought the operations of the poaching gang to light.

In addition to their illegal trapping, these men had been hijacking the furs of other poachers while they were on their way to market. The contraband pelts are frequently run by fast motor truck or motor car to New York, St. Louis, or Kansas City markets. Rival gangs wait near home stations where these machines are known to stop regularly for gas and oil. After they have held up the drivers and stolen the cargoes, they race for the same markets and not uncommonly, sell the furs to the same crooked dealer with whom the original gang had intended to do business.

Recently, half a dozen large-scale attempts to smuggle beaver pelts into the United States from closed season areas in Alaska have been exposed at ports along the Pacific coast. Customs officials at Seattle, Wash., not long ago, discovered 1,200 pelts hidden under a shipload of dried fish. Another time, they confiscated $15,000 worth of beaver skins which had been cunningly secreted behind false bulkheads in the hold of a vessel, and a third time, they made a haul almost as valuable when they found the furs concealed between decks on a tramp steamer.

SCIENTIFIC detective work, not long ago, uncovered a smooth-running "underground railroad" operated by fur poachers in several eastern states. This gang of trapper outlaws had worked out a system of shipping the pelts north across the Canadian line, putting bogus brands upon them, and sending them back to New York and St. Louis as Canadian furs. The law then permitted every beaver pelt, shipped from a Canadian province, to carry a special brand formed by tiny perforations produced by an [illegible] [illegible]

In Washington, [illegible] pelts set to work with high-powered [illegible] [illegible] the perforations of the real and the [illegible] brands. Many [illegible] the eye of the [illegible] many that [illegible] method of marketing the furs. A resultant change in the Canadian laws now requires that all beaver pelts shipped to the United States must carry [illegible] [illegible] a real Canadian [illegible]

In [illegible] another racket has caused [illegible] Gangs are preying upon fur farmers. They toss poisoned bait into dens of foxes and then cut their way into the enclosures and carry off the animals as soon as they are dead. In a number of instances, they have drugged female foxes and taken them alive to be sold in other parts of the country for breeding purposes. The owners of such farms are installing alarm systems and in some cases are encircling their pens with electrically charged wires to hold off the fur thieves.

BOUNTY faking is another activity of the outdoor gangsters. In many parts of the country, a bounty is paid for the scalps of predatory animals, such as wolves, wildcats, coyotes, and mountain lions, which prey upon livestock and poultry.

One gang in Kansas is said to have reaped a profit of nearly $150,000 from fake coyote scalps. It worked in collusion with several unscrupulous Missouri fur dealers, who supplied synthetic "coyote scalps" by the thousands at twenty-five cents apiece. Operating in eighty different counties, where a bounty of a dollar a scalp was offered, the crooks cleaned up a fortune. In many cases, they substituted dog scalps for coyote scalps.

In another instance, a gang was caught collecting bounty on the same scalps over and over again. It worked with dishonest county clerks as partners.

BECAUSE there is no standardization of bounty payments, each state setting its own price, crooks are able to defraud the government in another way. They trap the predatory animals in states where they are abundant and where the bounty is low and smuggle the scalps into the states where the bounty is high and the animals few.

For example, New Hampshire counties pay twice as much for wildcats as do Vermont counties next door. South Dakota has an eight-fold higher bounty on wolves than North Dakota. Colorado pays $50 for mountain lion, while Texas pays $[illegible] Montana $20, Wyoming $15, and Nevada $5. In Texas, four counties pay $50 apiece for wolves. This hodgepodge of conflicting fees has made the work of the bounty bootlegger comparatively easy.

What happens is illustrated in Wisconsin. This state offers a standing bounty of $50 for each mature timber wolf killed within its borders. The neighboring states of Michigan and Iowa have no wolves at all upon these animals. Consequently, scores of scalps are smuggled in from other states.

One crook who had been defrauding this state in this manner for some time was recently caught and sentenced to a term in the penitentiary. Every few weeks, he appeared at the county clerk's office with [illegible] scalps, which he had taken from a supply obtained in Canada and collected from $60 to $90. Officials finally became suspicious. They checked up on his movements and discovered that he had hidden his cache of scalps where he thought no one would ever find them—in the pulpit and parsonage of a country church.

ANOTHER form of bounty plundering made its appearance recently in the Pacific Northwest. Several of the states in this region had banded together to exterminate wildcats. A special bounty was offered for each one killed. To protect against fraud, hunters were required to bring in the right [illegible] when they collected their bounty money. This worked all right until one clever ring of crooks discovered the similarity between the foot of the wildcat and that of the ocelot, a small predatory animal of Southwestern and Central America. This gang began smuggling large numbers of ocelot feet into the counties where the fees were paid and collected a small fortune before the deception was discovered.

The federal government in Washington has been opposed to the bounty system ever since its inception. The contention of the government experts is that often the paying of such fees actually increases the number of predatory animals.

In recent months a number of states have been revising their bounty and game laws, seeking to cope with the activity of poachers and bounty fakers. Pennsylvania, for instance, now requires the presentation of a signed affidavit, as well as the delivery of the entire carcass, [illegible] the predatory animal, before any bounty payment is made.

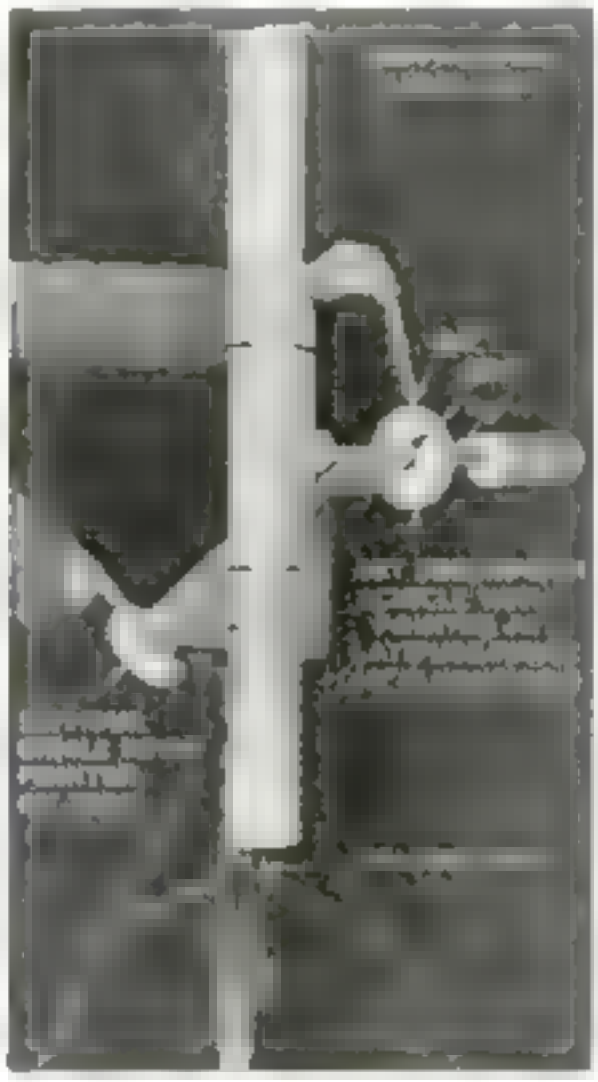
In the meantime, Federal agents and state game wardens are pushing ahead with their concerted drive on the gangsters of the open who are trying to defraud the government and exploit the wild life of the country.

MAKING AND USING AN EQUATORIAL TELESCOPE

(Continued from page 57)

enough to correspond, and use a lens of six-tenths inch focus for the eyepiece.

Almost any small magnifying lens of short focus will do for your eyepiece. The small ones called "linen counters" are suitable. They are usually mounted in a folding brass frame for the pocket. You can take this frame apart or mount it entire upon the end of the inner sliding tube.



This illustration shows how to adjust your equatorial telescope for use. Note that the object glass and the eyepiece are removed before the motion axis and tube are adjusted.

This telescope, made from two positive or convex lenses, will give you an inverted image, as all astronomical telescopes do.

In making my telescope barrel, I used a large cardboard mailing tube which happened to be of the correct length, thirty-six inches. I lined it with black paper to prevent confusion of the image by light reflected from the inner surface. A slightly smaller mailing tube about ten inches long was made to slide easily inside the barrel. To this the eye-piece lens was attached.

The magnified image you will see through a homemade telescope of this kind will not be perfectly sharp, but it will be clearer the longer you make your telescope. In other words, the optical errors of a simple spectacle lens are less important when the lens is of six-foot focal length than with a three-foot lens.

The next article will show you some interesting experiments in photographing the moon and certain stars through the telescope you have made. We shall also find out how to make constellation maps by means of an ordinary camera mounted upon your equatorial telescope mounting.

AIR LEAKS IN POLAR WASTE HOLD SECRETS OF COMING WEATHER

Continued from page 13

identify with ease the different moving masses. In addition, delicate instruments, known as aerometeorographs, ride in special streamlined housings on the wings and automatically record not only the temperature but pressure and humidity as well. These data collectors give the meteorologists a complete picture of the air layers and form the basis for their super-accurate predictions—said to be thirty percent in advance of the previous forecasts.

The same method is being tried for other parts of the country. Already Krick and his associates are drawing their air mass maps, reporting conditions from the Midway Island in the Pacific, across the United States to Bermuda and from the Bering Sea to the Gulf of Mexico.

Some of the moving masses of air in the northwestern part of the United States have been found to be as regular as clockwork. One of these is the curious Chinook Wind of the Rockies. It goes up the side of the mountain range warm and moist and descends dry and cool, gradually regaining its warmth as it nears the valleys.

IN HIS computations, Krick takes into consideration the effect of the mountains and valleys on the air currents along the 800-mile air line between Los Angeles and Salt Lake City. Ordinarily, for instance, the air flows down from the table lands of Utah and Nevada through the Cajon Pass, between the San Bernardino Mountains and the San Gabriel Mountains, into Southern California. Not long ago, one of the mail pilots had a thrilling experience near this pass when the currents suddenly shifted. His report of the rapid-fire change in the air masses was given special attention in working out the weather forecast for the following twenty-four hours.

Fred Kelly, veteran air-mail pilot, was bowling along with the Nevada wind on his tail. As he neared the pass, he found that the air was being forced directly over the mountains, falling like a cataract, only to be deflected upward after striking the earth in the Los Angeles basin. As he crossed the mountains, Kelly held the stick back to keep the plane climbing in the downdrafts. Suddenly, the machine was dealt a terrific blow. [illegible] in the wing [illegible]. The nose of the craft reared toward the sky. In one tick of a watch, the machine had passed from a downdraft, dropping at thirty miles an hour, into an updraft, rising at the same speed. The instantaneous vertical change was sixty miles an hour!

OTHER pilots, gathering data on air currents, have met experiences just as thrilling. One Weather Bureau flyer in the Middle West, for example, "passed out" at 15,000 feet, overcome by fumes from the engine. His plane drifted through the sky aimlessly for nearly twenty minutes before he regained consciousness and made a landing. Another pilot climbed a Weather Bureau ship over Chicago to 18,000 feet. At the peak, with the wind blowing eighty-five miles an hour and the temperature standing at forty degrees below zero, the engine coughed and stopped dead. Unable to make headway against the gale, he was carried backward and came down in a city street, one wing tip tearing through a line of telephone wires as he landed.

Meteor tracks, streaking fire across the sky, recently enabled astronomers to discover a new fact about air currents in the stratosphere. Through their telescopes, they observed vertical hurricanes rushing upward at 150 miles an hour through the thin air. Dr. Charles P. Olivier, astronomer at the University of Pennsylvania, reports that fourteen observatories, strung between New York City and Fredericksburg, Va., observed and measured these winds while charting the flight of Leonid meteors last November. Two unusually large meteors enabled them to make their discovery. They left lingering trains behind that floated and were driven upward at an angle of fifty-five degrees by the stratosphere wind.

ANALYZING the formation of clouds to study the movement of air masses is a recent innovation of German meteorologists. During the past year, they have been cataloguing the characteristics of clouds in relation to different air currents. Incidentally, they have learned the ear-marks of clouds through which a pilot may safely descend with the assurance that the air will be clear for several hundred feet above the ground. In this work, two new high-altitude cloud forms have been discovered. Named after their discoverers, the meteorologists, A. Lohr and Kurt Wegener, they are known as "Lohr cloud stripes" and "Wegener air waves."

For fifty years, scientists have believed there are tides in the atmosphere, just as there are tides in the sea. But only within the past two years have they been able to measure the rise and fall of the air pressure resulting from the attraction of the moon. According to Dr. J. Bartels, of the Department of Terrestial Magnetism of the Carnegie Institution, Washington, D. C., the comparison of tens of thousands of barometric readings has shown that when the moon is directly overhead, its pull reduces the pressure reading two-thousandths of an inch under the reading when the moon is on the horizon. There are four aerial tides each day just as there are in the ocean.

An announcement from Cambridge, Mass., reports an attack from a different angle upon the mystery of air currents and the things they carry in flowing from one part of the world to another. The Rockefeller Foundation has made a financial grant to the Massachusetts Institute of Technology for the purpose of carrying on researches on the distribution of pollen, bacteria and insects by the air currents.

Thus bit by bit, new facts are being accumulated about the currents and tides of the air.

HARDLY more than two centuries ago, scientists knew so little about the laws underlying movements of the atmosphere that they thought the trade winds of the tropics were formed by the "breath of the Sargasso weed." In the "Philosophical Transactions" of the Royal Society, Dr. Martin Lister, the English philosopher, stated that inasmuch as these winds were formed by the breath of only one species of plant, they naturally blew in one direction. On the other hand, the great variety of plants and trees giving off breath on land resulted in confusion and winds that blew from every point of the compass!

In the 200 years since that fantastic theory was published by the leading scientific society of the time, we have advanced far in the study of air. Today we are making increasingly rapid headway in charting and exploring rivers that run in the sky. Tomorrow, these researches, which the world now watches with eager interest, may solve the mystery of weather and enable us to understand the moving masses of air that play such a vital part in our lives.

FIND INVISIBLE CHEMISTS WITH A MICROSCOPE

Continued from page 43

golf ball delicately set upon a slender tee.

Naturally we shall want to add some of these specimens to our growing collection. To do so, we must first understand that the spores are of such a nature that, should we place them under a cover glass and seal them in, they would be crushed and rendered useless. So we must build up a cell.

A CLEAN slip glass is placed upon the turntable, described in a previous issue (P.S.M., Feb. '33, p. 47) and a circle of Canada balsam is made with a brush and permitted to dry. More circles are added one on top of the other until a cell wall of sufficiently high is built up. The bottom of the cell is then covered with another dab of Canada balsam and while the balsam is wet a few of the spores are gently [illegible] in from another slip glass. The cover glass is sealed in place with asphaltum or balsam and the balsam in the cell is cured.

Another [illegible] family of myxomycetes called Stemonitis Splendens, offers a rare form of beauty. Its stems form clusters that reach an inch high. Stemonitis Splendens is found on the shaded margin of a small pool. Some of the tiny stems, carefully collected, are placed in a box containing moist earth and carried home. The true beauty of this member of the family can only be appreciated through the 550-power objective.

The myxomycetes, in spite of their tiny size, play an important part in the world. They not only accelerate the decay of vegetable matter but they also break down organic combinations of chemicals and transform them into necessary fertilizers. These diminutive creatures are proficient chemists and it is conceivable that the human race owes its life to them. At any rate, they form a fine subject for investigation by the amateur.

As many readers, who have been taking photomicrographs, have written me of the trouble they have had in securing proper illumination of the microscope field, it seems advisable to describe a most valuable accessory.

PHOTOMICROGRAPHY, in its elemental aspects, is the same as ordinary photography, that is, the better the light the shorter the exposure and the better the picture. While a 500-watt lamp, costing $1.60, will serve this purpose nicely, the little arc light, a description of which follows, is still better and may be put together for a few cents. The carbons are of the five-sixteenths-inch variety and may be bought at any photographic supply house. They are held with set screws in two brass arms bent into the shape shown from one quarter by one-eighth-inch stock. Through the medium of two small angle pieces, these holders are screwed to the prong members of an ordinary light plug. When they are pressed down into a receptacle, the carbons are brought into the correct position for striking.

Either an electric toaster or the heater element from a bowl heater is used in series with the arc light to control the current. A small fiber handle is screwed on one of the brass members so that the arc may be struck and subsequently regulated.

It is best to place a tin housing over the arc when it is finished. The light escapes through a small opening in the front. A crude metal reflector placed back of it will also help. Glass will not do because it cannot withstand the heat.

This light is rich in violet rays and it will be found possible to take much better photomicrographs with it. The worker however is warned to shorten his exposure time if he has been using ordinary electric illumination.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

DENTIST SUCCEEDS ON "TRADING BASIS"

FEW men, who have lived in a small town for sixteen years have enjoyed a more ideal location but with the slump in business along with many of my friends I found that there was not cash enough to go around. The old saying that dentists and physicians are paid last proved true. I found myself truly in need.

Surrounding my town is one of the largest ranches in the world. There is only about eight percent of my county in small truck and dairy farms. Consequently, there are few people living outside of the town proper.

The town was supported by a branch of the Missouri Pacific General Office and shops. Two thirds of the force were soon set out. Families doubled up, moved away or rented small acreage out of town on which to grow something to eat, while I sat in my office and worried.

Fortunately, I heard a lecture given to the County 4-H Club. The subject was on preserving food grown within this county. An idea struck me: If they could eat what was grown here, so could I. So, when girls, boys or parents came in from the farms, I traded them my services for their canned foods. The idea spread rapidly and soon we had canned corn, peas, beans, tomatoes, kraut, pickle, canned beef, chicken, chili, sausage and pigsfeet. That winter we had many nice fryers, a few turkeys, fresh hog hams, home-cured bacon, eggs, butter and even fresh fish. Many patients came in and arranged to put up certain things that I would need.

I traded with carpenters, painters, garage men and tailors. I traded for sewing, washing, yard work and almost everything I could use or wanted except, rent, water, lights, gas, 'phone, materials and a few necessities that called for cash. How to get that cash was the problem.

My assistant carefully selected patients from our records who were still drawing salaries. Each week she sent out cards to a different group of these people showing the date they were last in my office and reminding them of the importance of regular care of their teeth. Our cash receipts picked up wonderfully. We have now inaugurated a return system for all of our patients.

Next she grouped the old accounts selecting those who probably could make payments and (Continued on p. [illegible])

Secrets of Success

DENTIST SUCCEEDS ON "TRADE" BASIS

(Continued from page 94)

carefully worded a letter asking them to make payments of fifty cents or a dollar at regular intervals thereby helping us to keep our doors open that we might relieve the suffering. The response was an agreeable surprise.

One idea brought on another. Our cards revealed many children within the school age. Their names were listed and a greeting sent each on their birthday. Many came in to thank us and have their teeth examined and repaired. We prize this system highly for children of today will be grown patients tomorrow.

Now we can say truly that the depression is light with us and this winter we will have plenty to eat and some cash. Above all we rejoice to say that we do not turn away anyone who is in need of our services.—J. V. C., Kingsville, Texas.

OREGON YOUTH CREATED HIS OWN "JOB"

THERE is at least one person in Oregon who is not going to sing a depression song in after years whenever the 1930-33 period is mentioned.

Standing amidst little wooden penguins, dogs, cats and other funny animals and fowl painted in brilliant hues, at his studio at Salem, Oregon, twenty-year-old Fred Blatchford smiled broadly when asked if the famous depression had hit him.

Why no, he laughed. "I can't say it has. You see, it's just the past two years that I have done this work on a really commercial scale and I have been pretty busy all the time since, and this year I had to put on three persons for full time employment besides myself.

Working with wood was a hobby of Fred's as far back as he can remember—and further, according to his parents. Dr. and Mrs. B. Blatchford of Salem. His mother tells that when he was a tiny child, the best way to keep Fred out of mischief was to give him a block of wood, some nails and a hammer.

When he was eleven years old he disposed of a few articles he had made of wood. The Blatchford basement was turned into a workshop and Fred set himself to learn the rudiments of handicraft. He began constructing clever novelties. Visitors at the Blatchford home saw these and desired to purchase them. Friends of these friends came to purchase more.

Two years ago Fred had his first bunch that his (Continued on page 96)

Secrets of Success

OREGON YOUTH CREATED HIS OWN "JOB"

(Continued from page 95)

novelties might sell in a bigger way. He packed a little suitcase of samples and hied himself to Portland. He admits that he was actually a little surprised when one of Portland's largest stores asked for the exclusive handling of the wood novelties at Portland. With furbished courage he marched on to other towns and met with equal success. He was eighteen then, and helping to put himself through his senior year in high school. Working up, he also completed a year of study in the law school of Willamette University at Salem. But Fred wasn't interested in that over-crowded profession. He wanted to work with wood and colors and decorative materials. When he is financially able, he confesses, he intends to study interior decorating.

In the meantime his father purchased a once-upon-time nursery near Portland. The place is overgrown with many varieties of wood that are dear to the heart of a wood lover. Fred now devotes all of his time to his wood work. The National American Legion convention at Portland in September, 1932, was a find to him. Fred heard opportunity knocking and he opened the door wide. As a consequence Legionnaires returned to their homes with many a funny little wooden animal, fowl, and what-not in bags and pockets. In due time orders began coming in from these home towns. Fred is now selling to almost every state in the Union and there is one less boy among the great army of "The Unemployed."—L. L. M., Silverton, Oregon

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

TESTS SHOW STRANGE NATURE OF CHLORINE

(Continued from Page 51)

good bleaching agent for certain dyed fabrics and flowers. By adding muriatic or sulphuric acid to it, you can produce chlorine—an excellent way for the amateur to obtain the gas in his future experiments. Bleaching powder also can be obtained in a prepared form at most drug and grocery stores, generally under the misnomer of "chloride of lime."

MANY organic substances can be made to react with chlorine. For example, drops of warm turpentine on a piece of paper immersed in a bottle of the gas will take fire spontaneously and produce large quantities of soot. A lighted candle and even a small gas flame placed in chlorine behave in a similar manner, but will soon be extinguished.

When carbon combines with chlorine, the very useful chemical carbon tetrachloride is formed. This is the liquid used in many types of fire extinguishers and also as a cleaning fluid for clothes and [illegible].

Using a small amount of carbon tetrachloride, the home chemist can perform an interesting and instructive experiment. Place some of the liquid in a dish, warm it gently, and pass the vapor [illegible] into a glass tube containing hot lead peroxide. The [illegible] lead peroxide changes, but watch the oxygen in the peroxide switching places with the chlorine in the carbon tetrachloride to form white lead chloride and gaseous carbon dioxide. The exchange of elements is what is known as *double decomposition*.

The white lead chloride remaining in the tube can be dissolved from the rest of the residue by washing it in hot water. Then by filtering and evaporating the liquid, the amateur can obtain the lead chloride for future use in his home experiments.

One of the most important combinations of chlorine is hydrochloric acid. Although it is a gas formed by the union of chlorine and hydrogen, it dissolves readily in water to form liquid hydrochloric acid. If the acid is slightly impure it is often referred to as muriatic acid.

When hydrochloric acid gas dissolves in the water, a noticeable amount of heat is given off. This can be shown by wrapping the bulb of a thermometer with a thin piece of wet cloth and holding it over the open mouth of a hydrochloric acid bottle. The hydrochloric acid gas given off by the acid will be absorbed by the wet cloth and the temperature will rise.

ALTHOUGH the amateur chemist can buy hydrochloric acid cheaper than he can make it, he can produce a small quantity of it experimentally to satisfy his own curiosity. Dissolve common salt in a small quantity of sulphuric acid diluted to about half its strength with water. The gas driven off when this mixture is heated is hydrochloric acid gas. If this is bubbled through water hydrochloric acid will result.

SECRET OF PURPLE GOLD SOLVED IN LABORATORY

GOLD ornaments found in the tomb of King Tut-Ankh-Amen were covered with a beautiful purple film. The mystery of this coloring has been solved by Prof. R. W. Wood, of Johns Hopkins University, Baltimore, Md. At the time of their discovery, some scientists claimed that the ancient Egyptians knew how to color gold. Wood, by laboratory tests, has shown that the purple is due to iron in the gold which had been hammered and then heated.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

MECHANIZING CANADA'S FAMOUS MOUNTIES

(Continued from page 39)

All this does not mean that the Royal Canadian Mounted Police have forsaken the horse. By no means. Every recruit is still required to be able to ride, to have some knowledge of the care and management of horses. Riding still has a place on the daily schedule of the training course. There is still stable duty to perform. There are still musical rides on occasion, still sports to play on horseback.

Nor has the picturesque mounted member of the force entirely disappeared. Horses are now few in number but where the vacationist goes, where tourists come in thousands, there the Mountie is still to be met riding a superb steed and wearing the famous scarlet tunic, dark breeches with wide gold stripe, and high, spurred, glossy riding boots.

MECHANICAL transports have even resulted in a change of uniforms. The wide brimmed sombrero has gone by the board—for the motorized Mounties. A flat cap, as worn by the army, the municipal and provincial police force, telegraph and bank messengers, has been adopted. It adds speed to the uniform, while it retains some of the romance associated with the Mounties. It is blue with a gold band.

Other changes have come about in the uniform. The motorized members now wear dark blue uniforms with gold stripe. Khaki has become a more worn colour by the members of the force, often with slacks instead of breeches and shining high boots, and minus the jingling spurs, the riding crop of the mounted divisions.

The mechanization process, the demand for a better and faster moving force has also invaded another field of duty. Typewriting is now a requirement for a successful candidate. A good stenographer, capable of using and repairing a typewriter, comes out of the training class. Six months of typewriting instruction is now included in the course for recruits.

That same demand for a better force has gone into acquiring better transport for those members who patrol the very far north, who in winter time cannot use motor boats, airplanes or other fast methods of transportation. Faster and sturdier dogs are being bred by the force at various points throughout Canada. Imported dogs the famous Borzoi wolf hounds are being bred with the husky dogs which are the beasts of burden in the northland. A sturdier, better coated and faster dog has resulted.

Will the machine age in the Mounted Police mean the end of romance, glamor and adventure? It is hardly likely that the mechanizing will spoil the reputation built up in the sixty years that the force has been in existence, that the annual reports will be less replete with tales of courage, daring and adventure, just because motor car, motorcycle replace horses for most of Canada's Mounties.

KENTUCKIAN'S SHOUT HEARD EIGHT MILES

Out of Kentucky comes the report of a man who, in a recent contest made his shout heard eight miles away. Loudspeakers, audible for dozens of miles, have been built, but nature's records for loud noises remain unapproached. Thunder has been heard as far as 100 miles away. What is believed to have been the loudest noise ever produced in history occurred when the volcano Krakatoa blew its top off in 1883, with a concussion that was heard at a distance of 3,000 miles.

PLAIN CLUES TO MOTOR ILLS

(Continued from page 58)

hard use or running over sharp rocks?"

"You bet it does," declared Gus. "Either a wheel bearing is worn or else something's loose in the steering gear. Either trouble would make the wheel wobble and grind itself to pieces on the pavement."

"Then take your lights," Gus continued. "They're another good source of clues. Between your lights and your ammeter you ought to be able to find out anything you want to know about your [illegible] system.

"Flickering [illegible] are a pretty good indication that there's a short somewhere in the [illegible] circuit. To find it, all you've got to do is turn on your headlights, then your [illegible] and finally the dash and dome lights. If the lights dim in all three cases, you've traced the fault to the tail light. If they only flicker when the headlights are on, look in the headlight circuit. The same thing holds true for the side lights and dome lights.

"If the lights flicker every time you switch on the ignition, look in the ignition circuit. Lights that flare up when you speed up the motor mean that there's a loose connection somewhere in the battery and generator circuit.

"Is there anything in all this stuff about smoky exhausts meaning trouble?" Canton asked.

"In a way, yes," agreed Gus. "Of course you're going to have a certain amount of exhaust smoke when the motor is cold, but when it starts to puff out in clouds, watch out.

"If it's white or light blue, you've probably got too much oil in the crankcase or else the oil you're using is too thin. A black smoke that's smelly means the carburetor's set for too rich a mixture and a gray smoke shows a combination of both troubles.

"But the exhaust isn't the only place where smoke will give a tip about the condition of your engine," Gus continued. "The blue vapor that sometimes puffs out of the crankcase breather pipe will tell you a heap about your piston rings and cylinders."

"What's the breather got to do with the piston rings?" asked Canton, puzzled.

"Just this," Gus [illegible] out. "If your rings or cylinder walls are worn, some oil is bound to work past them into the cylinders, where it's burnt and [illegible] blown back into the crankcase. Naturally, if it gets into the crankcase, it's going to leak out through the breather. If it just sort of drips out it probably doesn't mean much but when it comes out in puffs you can be pretty sure one of the pistons is leaking."

"Gosh, you're a regular Sherlock Holmes when it comes to detecting the faults in cars," Canton exclaimed admiringly as he touched the starter button.

"Well, you need to be to run a garage," Gus told him. "You've got to use your eyes and your ears as well as your hands to get along. No sense getting all messed up with grease and oil when you can find out things lots easier by looking and listening."

GAS TANK CAP MUST BE CHOSEN TO FIT CAR

If you lose the screw cap on your gas tank, be careful what type you buy to replace it. Just because it fits, it doesn't necessarily follow that it's the right cap for your car. Two types are manufactured—one with a small vent hole and one without the hole. The vented cap is for use on cars with vacuum tanks and the unvented cap for cars equipped with fuel pumps.

HIGH-FLYING CAMERAS UNCOVER MYSTERIES OF LAND AND SEA

(Continued from page 24)

the crops above are a shade less green. It was these faint variations in hue that the camera had recorded and which gave the negative its puzzling wind-on-water appearance.

Not many miles north of Hicksville, the eye of another camera caught sight of a mysterious object on the bottom of Long Island Sound. It looked like an immense black crown, 200 feet in diameter. The puzzled cameraman examined the film a dozen times. He couldn't imagine what the object was. He was so curious that, on his next air-mapping flight, he headed out over the water to find out. Several hundred yards offshore, he saw the answer to the riddle. When sand had been pumped up to fill in the site of the new Sunken Meadow State Park, nearby, the dredging had left a deep crown-shaped hole in the bottom of the sound which had registered pure black on the film.

Imagine discovering a city beneath the sea! That was the thrilling experience, a few weeks ago, of Capt. John T. Cull, a British Royal Air Force pilot stationed in Egypt. He was flying along the coast when he sighted something resembling a huge horseshoe on the bottom of the Mediterranean. He informed an Egyptian archaeologist of his mystifying discovery. A diver was sent down and he ascertained the horseshoe was formed by great columns of marble and red granite and the foundations of long-forgotten buildings. Among the relics he brought up was the head of a marble statue of Alexander the Great. Some experts believe the ruins represent the lost city of Canopus, which was a fashionable seaside resort at the time Rome ruled Egypt.

LIKE a tiny gnat in the sky, an air mapping monoplane toiled back and forth at 15,000 feet over the Mississippi delta country, two years ago. When the film, feeding through its camera, came from the developing tanks, later on, it recorded two objects on the ground that puzzled those who examined the negatives. One was a huge zigzag welt near the Mississippi, the other a tree doughnut, a perfect circle of trees enclosing a small grass plot and surrounded by open field.

Both of the objects the men learned on investigation had interesting histories. The zig-zag welt dated back to the War of 1812. It was the last remains of one of the redoubts thrown up to fortify New Orleans against the British. The doughnut of trees marked a long-abandoned loop in the lower Mississippi. The river had entirely altered its course and a rapidly-growing thicket of trees had sprung up in the rich soil of the abandoned bed.

One chance observation from the air, which set an airman wondering, resulted in flying investigators of the U. S. Department of Agriculture making extensive photographs of migrating ducks on the water of Chesapeake Bay.

The pilot was winging his way northward over the bay when he noticed a curious thing. The flocks of floating ducks below seemed to form distinctive patterns on the water. Can you tell the kind of wild duck by the pattern it makes? He couldn't answer the question. Neither could the Department of Agriculture. But the government experts were interested in finding out. So, not long ago, residents of the region saw an army camera plane plow back and forth methodically over the bay recording on film the duck patterns for study and comparison by government scientists.

Another army photographer, nearly 3,000 miles away, caught an air photograph of one of the most puzzling of all the puzzling mysteries which have been sighted from aloft. On the brown, sunburned top of a high desert mesa, not far from the Mexican border in southern California, his camera recorded the white outlines of giant men, strange four-footed animals and immense coiled rattlesnakes cut in the rock presumably by some people of prehistoric southwestern civilization.

George Palmer, a commercial aviator flying between Blythe, Calif., and Las Vegas, Nev., first sighted the mysterious figures on the mesa. A searching expedition from the Los Angeles County Museum set out to look for them. They approached within approximately a mile of the spot and inquired at a ranch house for large figures cut in the earth by the Indians. No one there had ever heard of them. It took the camera's eye view aloft to discover their position.

THIS was done by two Air Corps men, Lieut. Minton W. Kaye, pilot, and Sgt. Stephen M. Alko, photographer. They hopped off from March Field near Los Angeles and crossed the desert along the muddy flats of the lower Colorado.

"Flying across the desert," Lieut. Kaye writes in the Air Corps News Letter, "I was overwhelmed by the futility of finding anything in this great expanse of rock and sand. But Lady Luck was riding with me. Upon approaching the Colorado River, I had hardly made one turn to look the country over when I discovered directly below me an immense man stretched out upon the brown roof of the mesa as though he were taking a sun bath or gazing up at his Maker. What a thrill I got! I began circling, losing altitude, studying the figure. So intent was I that I did not notice other figures forming a triangle with a base of about half a mile. Sergeant McAlko motioned to look to one side, and I saw another figure of a man and then still another. I noticed also that there were figures of animals and snakes.

The next day, the men led the ground party to the spot. The largest of the triangle of giants measured 167 feet from head to toe and had an arm spread of seventy-four feet. The smallest figure was ninety-five feet high. They had been formed by scraping away the surface material which was dark chocolate in color and revealing the under rocks which were whitish-tan in hue. The secret of these sprawling giants remains hidden. Some archaeologists hazard the conjecture that they were carved on the roof of the plateau, facing upward toward the heavens, as a religious ceremony to attract the attention of the gods gazing down from above.

IN YUCATAN, a couple of years ago, relics of even older worshippers were brought to light by an aerial camera. Buried under a green glacier of tropical foliage, ancient Mayan temples no white man has ever seen, form mounds that rise above the level of the jungle. These mounds were recorded on pictures shot from a flying Sikorsky by Capt. Robert A. Smith.

One photograph alone is enough to make an archaeologist's mouth water. It reveals twenty such buried temples dotting the jungle within an area of ten square miles—temples no scientific expedition has yet been able to reach. (Continued on page 101)

HIGH-FLYING CAMERAS UNCOVER MYSTERIES

(Continued from page 100)

In the near future, a party of experts from the University of Pennsylvania hope to cut their way into this Promised Land of Archaeology.

It was on his trip to Yucatan that Capt. Smith accomplished one of the cleverest bits of camera detective work in the history of aerial pictures.

For years it has been known that somewhere under the vast forests of this region lie the remains of causeways built by the Mayans. Trees growing on such elevated highways, Smith shrewdly calculated, would rise slightly above the average level of the forest and thus would cast shadows when the sun's rays were coming almost parallel to the treetops. He took off from the Isle of Carmen, in Yucatan, just as the sun was tipping the eastern horizon and headed toward Belize, in British Honduras, out over "the desert," one of the blank spots on the map of the world.

Above this limitless waste of jungle, he snapped his pictures. The results exceeded his expectations. The photographs showed two fine black lines of shadow forming a giant X and running across the jungle straight as strings for nearly a hundred miles! They marked the exact location of the ancient buried arteries of travel.

Shooting a vertical picture during an air-mapping job, one of the McLaughlin Aerial Surveys photographers recently spotted a mystery in connection with an artery of travel, not in a Mayan jungle but in the heart of New York City.

The negative showed a crowded section of the city near the East River above Fourteenth Street. Like toy houses, all the buildings faced the streets except in half a dozen places. Here two or three dwellings in the middle of a block would be turned squarely as though someone had gone along and twisted them at an angle away from the street. While the cameraman was puzzling over this fact, he noticed that an imaginary line drawn through the curiously-twisted dwellings would strike an angling avenue running northeast from Astor Place.

An early map of the city cleared up the riddle. The offset houses were still facing the ancient line of the Old Fitzroy Road, a Manhattan artery which once led from Greenwich Village to the East River. The road had been abandoned in 1845, nearly ninety years before. Yet it was still leaving its imprint on the city, an imprint which had been lost sight of until the keen eye of the aerial camera added the puzzle of the twisted houses to the long list of mysteries it has discovered from the sky.

MODEL AIRPLANE FLIES SEVENTEEN MINUTES

Lighter than a feather, a one-tenth-ounce model airplane, built by John A. Bartol, of Roxbury, Mass., circled about for seventeen minutes and forty-seven seconds in a New York armory recently. The flight of the midget craft set a new national record. It was constructed with microfilm, or very thin cellulose, covering the wings.

PLANE CARRIES FOOD TO FAMOUS OCTOPUS

Ocean crabs are being rushed by plane from New York to Chicago for Oedipus, the famous octopus at the John G. Shedd Aquarium. These crabs come from the New York Aquarium and are believed to be the secret of Oedipus' longevity.

NIGHT LIGHTS YIELD NEW MARVELS IN THE GROWTH OF PLANTS

(Continued from page 73)

have found that the cost of growing various plants under electric lamps is not necessarily great

The following are a few costs reported by these men, based on tests made with electric current costing three cents per kilowatt hour

China aster forced to flower December 30 after planting in the fall, seven-tenth cents per flower Boston Yellow daisy, produced more flowers and longer stems, and flowered nineteen days earlier, at a cost of one and a half tenth cents. Lilac lavender stocks flowered twenty-nine days earlier, at cost of three and four-tenth cents per flower stem Shirley poppy, as sixteenth-hundredth cents per flower, with the unlighted control plants not blooming at all

The foregoing figures were obtained in lighting beds from six to ten p.m. each day using eighteen 100-watt lamps to light 200 square feet of bench space

LAURIE and Poesch have found that the installation of a costly lighting system is not necessary. Standard reflectors, sockets, and other equipment can be used Care must be taken, however, to see that the wires are large enough to prevent overloading

Some of the outstanding facts listed by the two Ohio State University investigators are

Clear-glass, gas filled mazda lamps of 50 or 100 watt size, burned from six to ten p.m. speeded up the blossoming of various potted plants, including Cineraria hybrida, Cineraria maritima, and Primula obconica

Geranium Cyclamen persicum and aspara- [illegible] increased in size under similar treatment

Among the annuals which exhibited [illegible] differences in blooming periods when given four hours of additional light each day are snapdragon, coreopsis, various chrysanthemums, alphonsus, gypsophila, fever few, stocks and many others Early flowering herbaceous perennials responding to light treatments include the Shasta [illegible] Coreopsis [illegible] Vista [illegible] Centaurea grandiflora and Achillea millefolium

The burning of lights to give additional illumination on cloudy days was found to be ineffective because the cost was too great for the benefits gained

Reducing daylight exposure by covering with cloth caused early blooming of poinsettia stems and chrysanthemums. Black sateen cloth, which can be used for several days was found best It should be suspended close to the plants

Application of shades too soon after planting caused short flower stems. Removing them too soon often caused uneven flowering Chrysanthemums produced under shade were the same as flowers which grew normally, except that the stem length was somewhat less By eliminating daylight from six p.m. to seven a.m., chrysanthemums can be speeded up twenty-five to fifty-six days, the tests showed.

FOR the benefit of others who may want to apply lighting control to plants, either for the purpose of making a greater profit or purely for the fun of it. Laurie and Poesch have made a few recommendations

For giving additional light, use 100-watt mazda lamps spaced four feet apart either way, and eighteen inches above plants. Each lamp thus covers sixteen square feet. Turn on the light at planting time for most plants and continue treatment until fully grown Use long day plants only, those which blossom in summer

For reducing light periods Plant chrysanthemum not later than June 1, and place shades over tops and around sides when plants are six weeks old. Remove shades on standard varieties a week or so after terminal buds show, and on pompons after buds show color For stevia plants, use black shades from September on, applying them at three p. m and removing them at seven a. m. Continue shading for four weeks

DR LAURENZ GREENE and associates at the Purdue University Agricultural Experiment Station, Lafayette, Ind., have been investigating the practical side of plant forcing. Their investigations were carried on with mazda lamps ranging in size from fifty to 1,000 watts, mounted in most cases in bowl reflectors and suspended fifty inches above the plant bench. Lamps were turned on and off with electric time switches, and periodic measurements of light intensities were made and averaged for each experiment

The Purdue tests showed that, in general, artificial light used to lengthen daylight periods causes earlier flowering, thus releasing valuable greenhouse space for other uses; induces each plant to bear more flowers, which helps lower their cost; and produces longer flower stems such as most persons prefer

Other findings of Greene and his associates include the following

Light from 50- or 100-watt lamps placed fifty inches above the plant bench stimulated growth almost as well as much larger lamps Low light intensities over relatively long night-time periods—ten or more hours—were found to be much better than high intensities over shorter periods

Some plants illuminated only when they were very young seedlings responded as much as those illuminated during their entire life. Some of these plants produced blossoms sooner than those which were treated all their life, while others seemed to derive more benefit from light treatments after they were more fully grown

Ultra-violet light of wave lengths shorter than that in sunlight proved injurious Ultra-violet sources should be screened in order to remove the harmful rays, it was found

An excellent cut flower crop of asters was produced [illegible] illumination supplementing daylight

Sweet Coast Blue pansy produced most flowers when lighted with a 100-watt mazda lamp in a white-enameled bowl reflector placed fifty inches above the bench and burned for ten hours every night during the life of the plant

Similar conditions caused the Orange King calendula to produce flowers in greater number and with longer stems

Easter lilies seemed to produce flowers earliest when given treatments with a 500-watt lamp for five hours each night, during the first twenty days after the plants appeared above the soil

YEAR'S DIRTIEST DAY IS FOUND BY WEATHER MAN

To sort hottest day of the year the coldest day and the wettest day of the year, meteorologists are now adding to the record the dirtiest day of the year The New York City Meteorological Observatory recently reported that December 10 was the dirtiest day of 1932 On that date, there was an average of 3.06 tons of dust and dirt per cubic mile of air above the city. The cleanest month of the year was April.

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Nature Invented All of Our Tools First

(Continued from page 15)

animal engineer was also the pioneer in inventing reinforced concrete, for that is what his building material of mud and branches really resembles.

If you were asked to mention one structure entirely original with man, you might think it safe to name the skyscraper, of which the Empire State tower is the supreme example. Yet even this giant among buildings was anticipated long ago in the structures reared by the termites of Africa.

THESE insects, popularly called white ants, construct their buildings of clay, which becomes so hard in the sun that several men can mount upon their tops without breaking them down. Under the domed roof are floors upon floors of apartments for various purposes, connected by tunneled passageways. It is a city under one roof, which is the term also applied to a big, densely-populated office building.

Perhaps when you hear that a termite's building is usually about twelve feet high you will think that our comparison with the 1,200 foot Empire State building is strained. Wait until you have compared the heights of these two structures with the statures of their builders. The Empire State building is only 200 times the height of a six-foot man, while the Termite building is over 500 times as tall as its quarter-inch-high architect and builder! Our most famous skyscraper would also seem a trivial accomplishment to a giant 250 feet high, which is the stature of a man, as seen by a termite.

Almost everybody knows that the paper upon which our daily news is printed is made from wood pulp. In this we merely follow the example of the oldest paper makers in the world—the wasps.

These hot-tempered insects had mastered the craft ages before the Chinese made the first paper produced by human hands.

When man needed to capture animals for food, he formed the idea of a trap, beginning with a crude pitfall and gradually perfecting his snares until he produced the spring steel trap. Yet for millions of years, nature had been using the same idea in a little North Carolina plant.

IT IS called "Venus' Fly Trap." When this trap is set, it stands with the two rounded halves of the leaf open. Three stout bristles, one of which acts as a trigger, stick up from the center of each half. Woe to the unfortunate insect that touches one of these, for the two halves come suddenly together, and the teeth that fringe the edges are instantly dovetailed like the fingers of clasped hands.

Modern industry has developed a number of trades in which the workmen must be constantly exposed to flying particles of dust. Sand-blasting is one of these. A stream of fine sand is driven by compressed air against the glass, through the openings of a stencil pattern, and flying sand and glass powder result.

If the operator breathed this constantly, the irritation would soon result in lung trouble. He is therefore provided with a mask, or respirator, which strains out the solid particles from the air by means of a fine metal mesh so that they will not be inhaled by the worker. One might think that this invention would be unnecessary in nature, yet almost every insect is provided with a device that is similar.

Many people do not know that insects do not breathe through their mouths. Their air is inhaled and exhaled directly through the sides of their bodies, by means of a row of openings called spiracles. Nature's respirators are the screens of minute hairs that protect these openings from the entrance of dust. If they were not provided, an insect's entire breathing apparatus would soon become useless.

LONG before primitive man hollowed out a log for a boat and learned to row it with two flattened clubs, nature had invented and perfected oars for the benefit of a little swimming insect called the water boatman. You can see him in the shallow water at the edge of any summer pond, jerking forward half an inch or so for each stroke of his oars. If you watch closely,

VILLAGE OF MATCH BOXES

When this model church is completed, nearly 10,000 match boxes will have been used, but the entire village, which this English plumber is building, will require over 4,000,000 boxes

you will see that the bristles along the edges fall flat during the forward strokes and spread out during the backward ones. So nature knew how to feather the oar from the beginning.

She is always strictly economical in making her inventions. The water-boatman's oars, for instance, are simply a pair of legs made over. This is the way evolution always works. If a creature has a new need to fill, in order to live, some part of its body is modified until it is adapted to the purpose. If man had observed nature's inventions more closely, he would have made some of his own devices thousands of years before he did.

Robert Fulton's steamboat was a side-wheeler, but when men began to build steam vessels for ocean travel, a different type of propeller was required. The screw was soon developed. Although it is now used to push forward every kind of self-propelled boat, from canoes to ocean liners, it was unknown a hundred years ago.

Yet among the tiny microscopic creatures called flagellates, who shoot rapidly through a drop of pond-water, the screw has been the accepted method of propulsion for untold ages. Just as an airplane propeller bores into the air ahead, dragging the body of the plane after it, so these screw-like animal-bodies bore into the water by vibrating their long whips ahead of them.

Every carpenter knows that the strongest joint to make at the corners of a box is the dovetail. Fingers of wood from two side pieces are made to interlock at the corner, like the fingers of clasped hands.

This method, like every other good principle of construction used by man, was originated first by nature. One has only to examine the lines where the separate bones of a skull are jointed, to find that each joint is a perfect dovetail.

No wonder that Smeaton, the great Scotch engineer, adopted the dovetail joint as a method of joining the stones in the foundation of the Eddystone lighthouse. The Eddystone rock is exposed to the full force of the winds and waves of the stormy English Channel. A previous stone lighthouse, built upon it, had been entirely swept away by the sea. When the work of building another was given to Smeaton, he decided to use the dovetail joint both in fastening the stones together and for fastening them into the surface of the Eddystone rock itself. That nature's method succeeded is shown by the fact that the Eddystone lighthouse still stands after a hundred and fifty years of assault by the elements.

Spinning and weaving are among the oldest human crafts. Their origin is lost in the mists that hide prehistoric civilization, yet still more ancient was the invention of both these sister arts by nature, and so well were they learned by the silkworm that its spinning and weaving is of enormous commercial value.

While the silkworm was learning to spin and weave, there were many other pupils in the class. For example spinning and weaving was taught to the legless larva of the ant, in order that it also might make itself a cocoon in which to spend the sleeping period that precedes its transformation into the mature, six-legged insect.

EVERY well-built theater, factory, and mine now has a ventilating system. But the ventilating system is only a recent development in man's architecture, while its principle has long been understood and used by the bees. The results that they desire in their hives are the same that man aims at, but instead of forcing a current of air by power-driven fans, the bees produce one by means of their wings. A number of bees form a long line at the entrance to the hive. Humming loudly and restlessly beating the air with their wings, they keep a current of air in motion until the temperature and moisture of the interior are reduced.

Long ages before any cowboy ever swung his mighty noose over the horns of a fleeing steer, nature had developed the idea of a snare to be thrown from a distance.

One of the first creatures to benefit by the invention was the chameleon. With its aid this creature can capture a butterfly or other insect from a distance of as much as six or eight inches. The chameleon's lasso is not, however, a sliding loop, or noose. It is simply his sticky-ended tongue. If the chameleon can, without alarming his intended prey, creep up within striking distance, the butterfly is doomed. With a speed too great for the eye to follow, the long tongue shoots out, its gluey end touches the insect, and the latter disappears into the waiting mouth.

The chameleon's lasso tongue is an outgrowth of necessity. The creature lives in trees where the footing is too insecure for leaping upon the prey. Instead, it creeps up to roping distance, and the lasso does the rest.

No matter how original a human invention may seem, it is almost certain that nature thought of it thousands of years ago. That is why science now advises inventors to search out and study nature's mechanical devices for valuable mechanisms that can be adapted for human use.

● ABOVE — A. M. WILKINS, air-mail pilot for Transcontinental and Western Air, Inc., has flown the night air mail over 150,000 miles. It takes healthy nerves to hang up a record like that!

● RIGHT—AT THE END of his night run A. M. Wilkins joins a fellow pilot, W. Niedernhofer, at Newark Airport, the Eastern Terminal of TWA, for a chat and a smoke. "Camels never ruffle or jangle my nerves," Wilkins says.

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